

The flora of the liassic clay meadows in south and east Worcestershire. (From the Forest of Feckenham to the south-east).

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Introduction:

There is a cline of grassland vegetation (National Vegetation Classification or N.V.C.) types from South-East Worcestershire to the North-West which reflects soil type and underlying geology.

It ranges from true calcareous grassland – Upright brome (*Bromopsis erecta*)/Tor Grass (*Brachypodium pinnatum*)/Upright Brome with Tor grass (*B. erecta* & *B. pinnatum*) – calcicolous grassland or N.V.C.s: CG3c/CG4/CG5, around Evesham and along the Avon valley; via hybrid calcicolous Upright Brome type grassland with mesotrophic knapweed/crested dog's-tail (lady's bedstraw sub-community) type grassland or calcicolous/mesotrophic N.V.C.s: CG3 MG5b on the liassic farmland around Naunton Beauchamp the Flyfords and Inkberrow; to the renowned, though transitional knapweed/crested dog's-tail (meadow vetchling sub-community), and knapweed/crested dogstail (heath grass sub-community) types, N.V.C.s: MG5a and MG5c of the Hanbury/Eades meadow groups in central-Eastern Worcestershire on the triassic mudstones; through to MG5c and almost Calcifugous Grassland, the common bent with heath bedstraw (Yorkshire fog grass/white clover sub-community) or N.V.C.: U4b vegetation on higher ground and older permo-carboniferous geologies and breccias around the Clent Hills in the North.

Ecologists and field botanists talk glibly about the neutral MG5 (Centaureo-cynosuretum or knapweed/crested dogstail grass) “dry meadows” for which Worcestershire is nationally renowned, yet there is a whole rainbow-spectrum of markedly different sward types and floristic combinations occurring within this category of neutral

meadow dependent on local geo-edaphic conditions, topography, hydrology and aspect, whether the site is ridge/furrow terrain and so on.

This paper aims to explore the contrasting range of community types, and how this can change fairly markedly across short geographic distances.

Maps tables and photographs are used to illustrate this cline and highlight the intrinsic differences between the meadow types. But I am emphasising the importance of the Liassic geology grasslands, in particular those in south-east Worcestershire – Forest of Feckenham (FoF) and bordering the Avon valley.

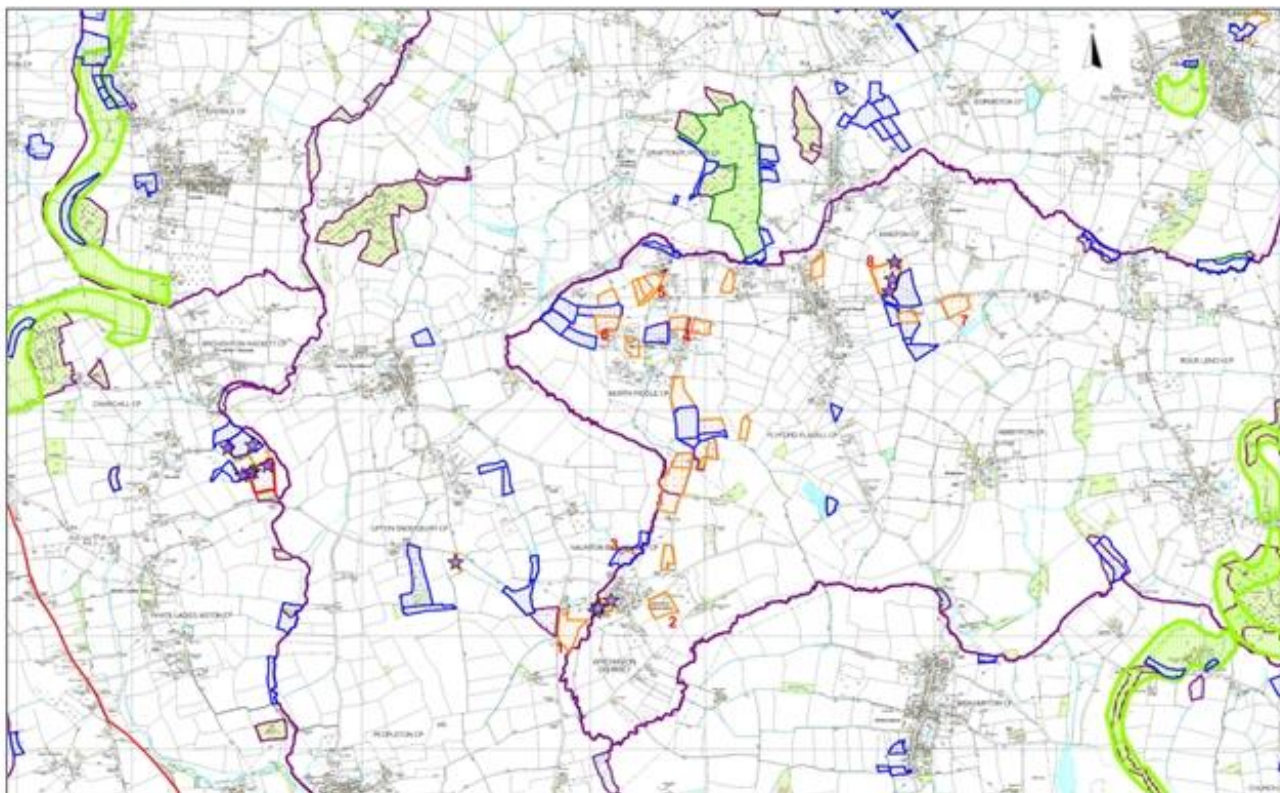
The differences between meadow types have implications for management such as the timing and intensity of grazing, species and breeds of livestock used to graze and maintain the sward and mowing.

Sward types should be carefully taken into consideration when planning and conducting meadow enhancement and translocation projects (donor-receptor transfers).

The importance and in some senses, uniqueness of the N.V.C. CG3-type liassic clay meadows in the South-East FoF and Piddle Brook catchment cannot be over-stated, especially as the calcareous swards of these ridge and furrow fields are and have been under a high degree of threat from agricultural intensification. To quote A.W. Reid in the Geology and Soils section of ‘*The Flora of Worcestershire*’ (Maskew 2014): “*The Blue Lias (strata) ... stretch northwards from around Naunton Beauchamp and these parts of the Lias are the most interesting botanically ... the northern section of the Blue Lias has a number of small unimproved grasslands still remaining, but these remnants are under constant threat and continue to decline*”.

Forest of Feckenham -South: Piddle/Flyford Meadows Liassic Group

(ORANGE-STIPPLED)



01. Map representation of Meadows on Blue Lias formations. The Naunton Beauchamp/Piddle Brook/Flyford cluster
Cross reference with table 1.

Table 1 (below) shows the frequencies (whole-site walkabout) of species within 6 different meadow sites, depicted on the map at figure 1. The DAFOR ratings are used, where 1=R –rare; 2= O-Occasional; 3 = F/LF – Frequent or locally frequent; 4 = F – LA/A – Frequent to Locally abundant, or abundant; 5 = A-D – Abundant to

dominant (dominant normally highly unlikely in species-rich grassland).

The table can be split into row sections (as per Rodwell): top section includes the constant species for this community; middle two sections include the preferentials and differentials; fourth section at bottom of table includes the associates.

TABLE 1 (after Rodwell J.S. British Plant Communities Volume 3. A synopsis version of Floristic table for CG3 *Bromopsis erecta* grassland)

Meadow sites	(1) Naun Ct (x)		(3) pbmdw	(4) Moat Ho	(5) GroveFm	(6) Tolleys	(7) Humpy		(8) Portway (W)	
Species										
<i>Bromopsis erecta</i>	2	(6)	4	4	3			2		3
<i>Sanguisorba minor</i>	3	(7)	3	3	3					3
<i>Carex flacca</i>	2	(8)	3	3	3	3		4		3
<i>Plantago lanceolata</i>	3		2		3	3				
<i>Lotus corniculatus</i>	4	(7)	4	4	4	4		2	(2)	3
<i>Festuca ovina</i>				2				2		
<i>Leontodon hispidus</i>	2	(4)	2	3	3	3			(2)	2
<i>Centaurea nigra</i>			2				1	2		
<i>Polygala vulgaris</i>										
<i>Senecio erucifolius</i>	2			2	1					
<i>Rhinanthus minor</i>										
<i>Galium mollugo</i>								1		
<i>Achillea Millefolium</i>	3		3	3			4	3		
<i>Daucus carota</i>				2	2		1			
<i>Hypochaeris radicata</i>										
<i>Prunella vulgaris</i>	3		2	3			3	3		
<i>Bellis perennis</i>	4		3	3	4			2		
<i>Medicago lupulina</i>	3			3	3	3		1		3
<i>Knautia arvensis</i>					1					
<i>Viola hirta</i>								1		
<i>Centaureum erythreum</i>										
<i>Ranunculus bulbosus</i>	3		4	3	3	3		4	(5)	3
<i>Tris etum flavescens</i>	4		4	4	4	4			(2)	4
<i>Lathyrus pratensis</i>	2		2							
<i>Primula veris</i>	2		2	2	2		1	1		
<i>Leucathemum vulgare</i>	2		1				3			
<i>Ononis spinosa</i>	2			2				1		2
<i>Festuca arundinacea</i>	2									
<i>Centauria scabiosa</i>				1						
<i>Cirsium acaule</i>	1		1	2	2			1	(1)	
<i>Briza media</i>	3		3	2	3	3		3	(3)	
<i>Pimpinella saxifraga</i>	1			2					(1)	
<i>Helictotrichon pratensis</i>								1		
<i>Linum catharticum</i>				3			3	1		
<i>Plantago media</i>	2			2	2			1		
<i>Galium verum</i>	4		4	4	4	4		3	(4)	4
<i>Pilosella officinarum</i>	2				1					
<i>Helictotrichon pubescens</i>					1					
<i>Succisa pratensis</i>					1					
<i>Brachypodium pinnatum</i>	3							3		
<i>Filipendula vulgaris</i>			3							
<i>Tragopogon pratensis</i>	1						1			
<i>Agrimonia eupatorium</i>	1		1	2	1			1		
<i>Potentilla reptans</i>			2							
<i>Anthoxanthum odoratum</i>							4			
<i>Anacamptis pyramidalis</i>				1	1					
<i>Ononis repens</i>										
<i>Trifolium fragiferum</i>	2				3			1		
<i>Lotus glaber</i>							3			
<i>Trifolium dubium</i>	4		2		4		3			

Table 1 Notes: 1=ocasional/rare; 2=Locally frequent; 3= Frequent; 4= Locally abundant-abundant; 5 = Locally dominant//Constants: Frequencies 3&4 yellow highlighted; preferentials /associates: Frequencies 4 highlighted only. Average abundance levels per quadrat (second column) shown only where recent data available. (X) denotes a meadow site damaged or destroyed since 2000.

From the frequency figures and looking especially at the higher value species, 3 & 4 (highlighted yellow), it becomes clear from the community constants and preferentials that there is a high incidence of plants one would normally associate with swards on limestones

and chalk-derived soil horizons, rather than more typical neutral clay loams and sandy clay loams characteristic of much of the county of Worcestershire, especially through central areas (the mudstone geology).

Most of these meadow sites on this liassic plain exhibit historic ridge/furrow terrain – some may be pre-enclosures in origin. This is an important factor which will emerge in discussion below.

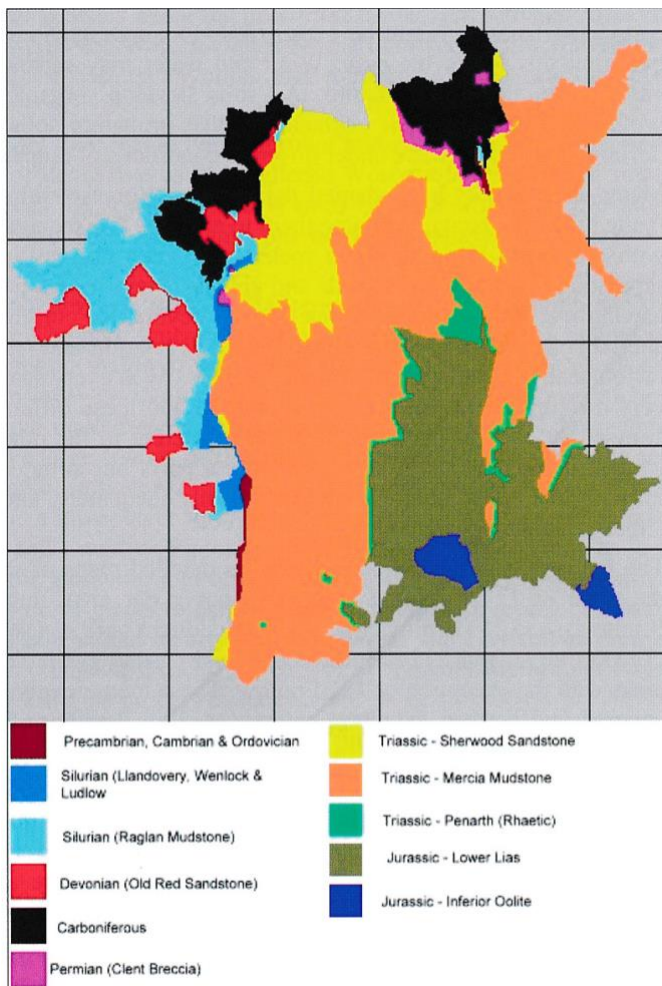
The more species-rich swards in this locality are to be found on the remnant patchwork of meadows along a 1.5 Km wide corridor following the vale of the Piddle Brook, and typically the richest flora occurs along the free-draining and lowest fertility ridge tops and shoulders. This tendency is especially marked where there are strong/tall ridges and particularly at sites with north to south ridges on south-facing slopes. The sward flora along these ridge tops often grades to an upright brome *Bromopsis erecta* type. Typical suite of species might include: grasses Upright brome *B. erecta*, yellow oat-grass *Trisetum flavescens*, Quaking grass *Briza media*, Tor grass *Brachypodium pinnatum* - occasionally, sometimes hairy oat-grass *Helictotrichon pubescens*. These can be interspersed with patches of Glaucous Sedge *Carex flacca*.

The more frequent (3&4) dicotyledonous herbs tend to be drought and graze resistant and rosette plants, or rhizomatous species, especially: bulbous buttercup *Ranunculus bulbosus*, common daisy *Bellis perennis*, lady's bedstraw *Galium verum*, Bird's-foot trefoil *Lotus corniculatus*, Lesser Trefoil *Trifolium dubium*, salad burnet *Sanguisorba minor*, cowslip *Primula veris*, rough hawkbit *Leontodon hispidus*, yarrow *Achillea millefolium* and creeping cinquefoil *Potentilla reptans*. Less frequent but still patchily common are slightly more prominent and leafy species – umbellifers such as pepper saxifrage *Silaum silaus*, burnet saxifrage *Pimpinella saxifraga* and wild carrot *Daucus carota*; bushier and shrubby legumes such as common and spiny rest-harrow *Ononis repens*, *O. spinosa*. Other typical species are hoary plantain *Plantago media*

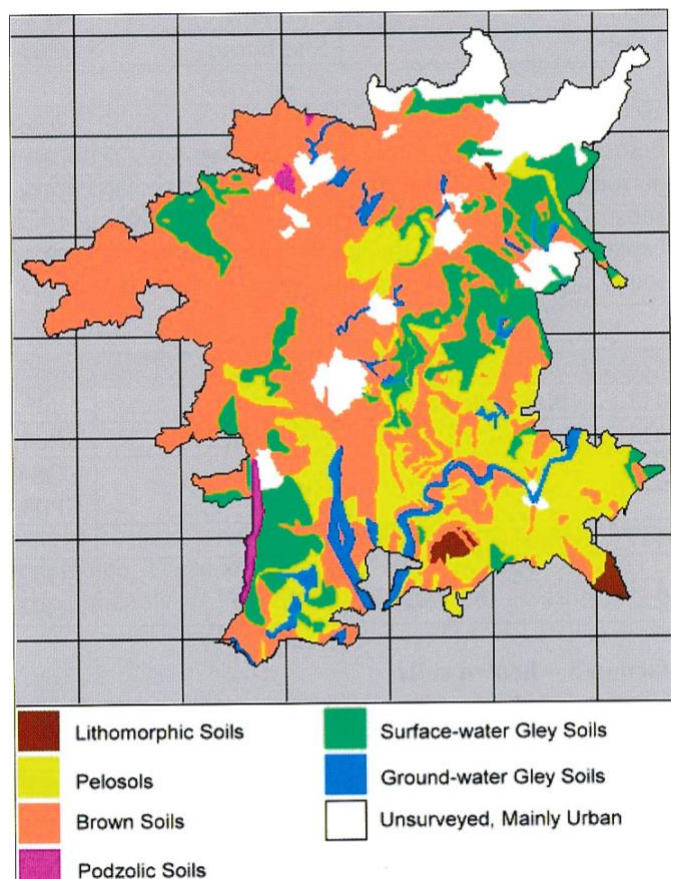
and agrimony *Agrimonia eupatorium*, much more occasionally. Dropwort *Filipendula vulgaris*, fairy flax *Linum catharticum*, dwarf thistle *Cirsium acaule* and, perhaps most local of all, pyramidal orchid *Anacamptis pyramidalis*. Strawberry clover *Trifolium fragiferum* may occur on trampled ridges or where there is impactation from tractors or farm machinery. Lastly, but not least, there is the nationally scarce legume virtually confined to this corner of Worcestershire: the narrow-leaved bird's-foot trefoil *Lotus glaber*. A selection of images of this flora is shown at Plate 1).

Dependent upon local microscale topography, I would contend that all of the above key out most satisfactorily within NVC scheme (dichotomous key) to a sub-community of CG3, *Bromopsis erecta* grassland than to the more neutral/calcareous MG5b. Prime examples of sites where this kind of sward is prevalent are the ridge and furrow section of Piddle Brook Meadows (Worcestershire Wildlife Trust (WWT) reserve), Moat House meadow North Piddle (private) and Humpy Meadow (WWT reserve). The flora of these sites, especially rosette species like hoary plantain or dwarf thistle benefits when occasionally hard grazed especially by sheep, or rabbits or horses, and especially if there are some anthills allowed to persist.

These near-CG3 clay ridge tops - and it is mostly the ridge-tops - in the South East FoF are near unique in the County. They are characteristic of soil types overlaying Liassic geology known as Calcareous Pelosols (see maps). See appendix for explanation of technical terms.



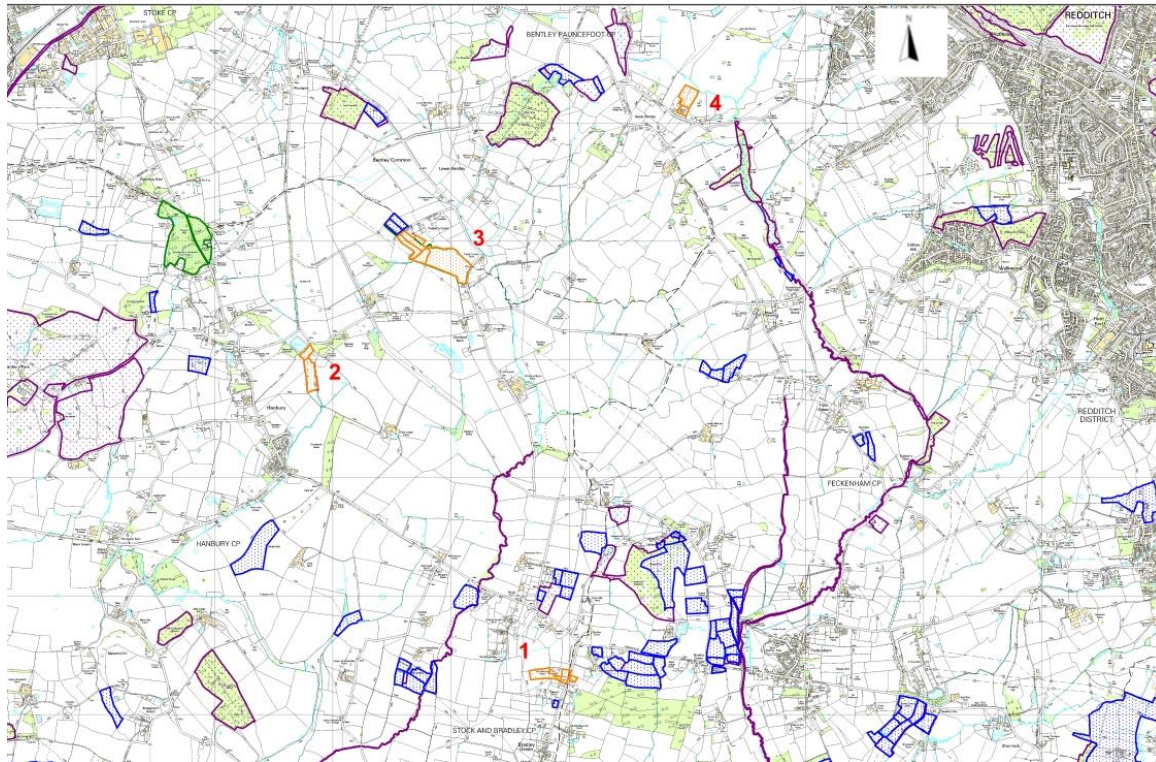
Simplified map of solid geology of Worcestershire showing the extent of Liassic geology. (From *Flora of Worcestershire* with permission of Roger Maskew).



Soil map of Worcestershire showing extent of calcareous (stagnogleyic) pelosols of the Evesham series 411 b and Worcester series 431 in South and East of the county. (From *Flora of Worcestershire* with permission of Roger Maskew).

I shall now select some contrasted examples of swards from meadows further north from central Worcestershire, more typically MG5a and circum-neutral and slightly acidic MG5c to highlight the differences in sward community composition (refer to Figure 2 – map and table 2, below)

Forest of Feckenham - Central: Meadows on Mudstones/Mixed Geology (ORANGE-STIPPLED)



02: Map representation of meadows on mudstones and mixed geology formations – Hanbury/Bentley cluster. Cross reference table 2 below.

Table 2 (after Rodwell J.S. British Plant Communities Vol 3). Synopsised version of Floristic table for MG5c *Centaurea nigra*/Cynosurus/Danthonia grassland)

Meadow site	(1) Old Rec mdw	(2) Fishpools cott	(3) Eades/Fosters Top mdws	(4) Callow Farm
Species				
<i>Holcus lanatus</i>				
<i>Centaurea nigra</i>	2	3	4	2
<i>Agrostis capillaris</i>				
<i>Lotus corniculatus</i>		3		
<i>Anthoxanthum odoratum</i>	5	3	4	4
<i>Prunella vulgaris</i> ,	3	2	3	3
<i>Leonodont autumnalis</i>		2	3	
<i>Luzula campestris</i> ,		2	3	
<i>Potentilla erecta</i>		2		3
<i>Succisa pratensis</i>	1	3		2
<i>Pimpinella saxifraga</i>				
<i>Stachys officinalis</i>	2	1		
<i>Conopodium majus</i>		3	5	2
<i>Hypochaeris radicata</i>			3	2
<i>Achillea ptarmica</i>				
<i>Alchemilla f-v</i>				
<i>Cirsium palustre</i>				
<i>Ajuga reptans</i>	2		3	3
<i>Scorzoneroidea autumnalis</i>		2	2	2
<i>Filipendula ulmaria</i>				
<i>Lathyrus pratensis</i>		3		
<i>Primula vera</i>				
<i>Serratula tinctoria</i>	3	2	1	
<i>Ranunculus acris</i>		3		
<i>Leontodon hispidus</i>		3		
<i>Heracleum sphondylium</i>				

Table 2 shows the frequencies of a species association which equates to MG5 and MG5c – much more characteristic of central and north FoF on mixed geology and Triassic mudstones. (see also map at 02 showing the selected meadow sites, including the Eades/Foster’s Green NNR/SSSI meadows complex). Soils here are typically stagnogleyic argillic brown earths of Worcester and Whimple series, sometimes slightly acidic but often base-rich.

The graminoid background sward tends to be composed more strongly of Fescue/Bent and sweet vernal grasses – and the broad leaved herbaceous element, as well as the more constant typicals: knapweed *Centaurea nigra*, birdsfoot trefoil *L. corniculatus*, meadow vetchling *Lathyrus pratensis* includes higher frequencies/occurrence of- pignut *Conopodium majus*, devil's-bit scabious *Succisa pratensis*, betony, *Stachys officinalis*, saw-wort *Serratula tinctoria*, tormentil *Potentilla erecta*, bugle *Ajuga reptans*, self-heal *Prunella vulgaris*, meadow buttercup *Ranunculus acris*. Also on damp, flushed and less well grazed swards there is a strong cyperaceal element – e.g. field wood-rush *Luzula campestris*, spring sedge *Carex caryophylla* and marsh plants such as sharp- lowered and jointed rush *Juncus acutiflorus*. *J. articulatus*. Common spotted orchid and if pH lower and sandy enough heath spotted orchid *Dactylorhiza fuchsii* and *D. maculata*, are much more frequently occurring here than on the pelosols and heavy clays. Finally, as one progresses further north and west in the county (the extreme end of spectrum is meadows around Chaddesley woods and the Clents) a species more typical of Pennine and Yorkshire dales sub-montane sweet vernal grass/wood cranesbill (NVC:MG3) grasslands becomes prominent. Zig-zag clover *Trifolium medium* is often conspicuous and sometimes near invasive in north Worcestershire Swards, tending to form large clonal patches which often overwhelm other sward flora. *T. medium* is generally quite scarce or local on FoF and south-eastern pelosol clays and pignut *Conopodium majus* virtually unheard of! A selection of some of these species is shown in Plate 2.

Resumé and concluding thoughts.

As a surveyor and field-botanist with 20 years of experience, carrying out NVC and Phase 2-level assessments of grasslands sites all across Worcestershire including new meadows, local wildlife sites, SSSIs, Worcestershire Wildlife Trust nature reserves and so on, it has become apparent to me that the lime-rich grasslands of the clay pelosols, especially the historic ridge and furrow grasslands have a unique and distinctive sward character all of their own, with a range of species almost mutually exclusive of those from more neutral and acidophilous mudstone and mixed geology flora to the north and centre of the county.

One could not expect to find highly calcicolous plants such as spiny restharrow, dwarf thistle, salad burnet, narrow-leaved bird's-foot trefoil and strawberry clover on the mudstones. Conversely one is extremely unlikely to encounter species of neutral and acid soils on the clays, pignut, zig-zag clover and tormentil being classic examples. Some of the dot-maps in the 2014 *Flora of Worcestershire* nicely illustrate this.

Why is all of this important and significant? Well, I think this is primarily important for habitat conservation and conservation management reasons, and those reasons include the following broad categories.

Rarity and restricted area of occurrence.

The Liassic (pelosolic) meadows occupy a restricted geographical zone within the county lying mostly to the south and east of the Worcester-Alcester A422, and a little north towards the southern edges of Redditch. Their significance within the spectrum of so-called “neutral” grasslands is often unrecognised and in my opinion they are underrated by Worcestershire's inhabitants and this applies across the board, to conservationists, ecologists, grassland specialists, landowners, farmers, site managers and especially local residents who are largely oblivious of what is on their doorsteps, and for its natural heritage value.

It should be pointed out though, that Worcestershire Wildlife Trust has in recent years acquired three of these blocks of meadowland as nature reserves.

Vulnerability/threat factors.

This also happens to be an area of the county where the demographic has changed drastically over the past 20- 30 years. Many of the older and more ‘traditional’ farming families have either retired, moved on or died out, and have been replaced by an influx of wealthy professionals buying holiday homes, non-farmers acquiring land for equestrian pursuits and riding schools. And, importantly, also by large agribusiness concerns who sub-contract or let out to tenants who, partly because of incentivisation to convert to arable production supported by Common Agricultural Policy subsidies, have ploughed the old grassland. It has to be said too, that some of the smaller meadow-land parcels have fallen through the protective net of the Environmental Impact Assessment (England) (Agriculture) (No.2) Regulations 2006, since, bizarrely, meadow blocks under 2 Ha are not subject to the regulations.

Due to a combination of these factors, the area between Pershore and Inkberrow (Piddle valley) has seen the loss or damage to at least 30ha of unimproved species-rich old meadows, due to ploughing as well as other forms of grassland improvement since the start of the millennium¹

Specialist Management.

The CG3/MG5b and sub-variant swards often benefit from periods of hard grazing. Practitioners wishing to protect, conserve and restore Liassic meadows to optimum condition should consider a cycle of two or so years of tight grazing by sheep or horses or light-weight breeds of cattle, alternating with late-season mowing for a hay crop maybe one year in three. The graze-resistant low growing herbs, the hemicryptophytes, can also benefit from an ‘early bite’ which will cut down coarse grass thatch and reduce the more competitive grass species

Background wild grazing e.g. by rabbits also helps maintain these kinds of sward, but the current national decline in rabbit populations is an ongoing concern.

Re-creation and translocation schemes.

Conservationists who are considering re-constructing meadows, in order to create a wider resource of this meadow type, and for providing landscape connectivity for wild pollinators and beneficial insects should ensure that the donor meadow (the source of seed or hay) for spreading on receptor sites should both be located in close proximity and on the same soil and geology. Interchange between the localities with mixed geology neutral/acid meadows and Liassic meadows is undesirable and should be avoided.

Where do we go from here? – the need for further research, data gathering and survey.

My contention in this paper has been that the Liassic clay and Blue Lias grassland flora of South-East Worcestershire, and the suite of species occurring in this enclave, particularly on ridge and furrow terrain, are almost unique amongst Worcestershire meadows. I have not come across closely matched swards anywhere else I have surveyed, for example the Malvern Chase corridor, the Silurian areas of west Worcestershire, the Tenbury arm, the centre of the county (mudstones), and so on. Not even the limestones of the Broadway Cotswold scarp or Bredon Hill, where there are eyebrights *Euphrasia* spp, common rockrose *Helianthemum nummularia*, wild thyme *Thymus polytrichus*, wild basil *Clinopodium vulgare*, squinancywort *Asperula cynanchica*. These species add a further layer of diversity, but they are characteristic of lithomorphous and rendzina-type soils, not the heavy low-lying clays.

Against the background that the liassic meadows are experiencing declines, with an increasing degree of risk from human land management activities, what questions am I asking?

First: is this enclave of heavy clay ridge and furrow meadow flora found further afield? I know of more scattered sites away from the Piddle Brook corridor – e.g. the Lenches, Evesham and River Avon valley-side scarps, Charlton and Fladbury area. I discovered a

further site only this summer, 2018, in the Lenches which does not appear on any grassland inventories and has not received survey coverage. But what of further east? The Bretforton – Honeybourne – Littletons - Pebworth “wedge” has much old ridge and furrow topography on the Lias, but surviving meadows are scant in the landscape because of the recent history of grassland improvement. Further east in Warwickshire and maybe Northamptonshire, on the Liassic geology? I have no information about similar grassland floristics on the clay soils there. Perhaps this highlights a need for comparative studies.

Second: The above brings me onto further research. Is there published literature? Have any local botanists carried out recent survey and monitoring. If so, where?

Third: Fauna especially dependent invertebrates. What do we know? For example, which pollinators such as mining bees, hoverflies and which beneficial insects are dependent on or prefer for example spiny rest-harrow for food and a nectar source or indeed for any part of their life cycle?

Fourth & Finally: History and past management. Sources of information are needed from local farmers, historians and

archaeologists (interviews, oral histories and so on). Harry Green has a library containing a few old photos, for example Humpy Meadow near Flyford being grazed by cattle in the 1970s. Are there more?

Acknowledgements:

My thanks to landowners and owners of private sites (Local Wildlife Sites and others) outside of Worcestershire Wildlife Trust nature reserves who have given access permission for survey and monitoring of their meadows. Many thanks to those who provided pictures to illustrate the flora.

References and sources

¹Michael Liley – data based upon Local Wildlife Site grassland monitoring and surveys carried out in the parishes of Grafton Flyford, Naunton Beauchamp and Pinvin; 2000-2018. Also Worcestershire Wildlife Trust Grassland Condition Monitoring report to Worcestershire County Council in 2010.
Maskew. R. 2014 *The Flora of Worcestershire* (2014). Privately published, R. Maskew.
Rodwell J. S. 1992. *British Plant Communities*. Volume 3. Cambridge University Press.

PLATES 1 AND 2 ILLUSTRATING THE FLORA FOLLOW ON THE NEXT PAGES.

Appendix.

A glossary of technical terms used in the text

Technical term	Best definition	Abbreviations
National vegetation classification	Systematic classification of 250 natural and semi-natural vegetation types occurring in British Isles	N.V.C.
Calcareous grassland	Grass sward vegetation on chalk or limestone soils with high calcium and magnesium content (higher pH levels)	C.G. series nvc codes
Mesotrophic grassland	Grass sward vegetation on neutral or circumneutral clay or clay-loam soils (medium pH levels)	M.G. series nvc codes
Calcifugous grassland	Grass sward vegetation on acid soils, often free draining or sandy or sandy clay-loams – can also occur on peaty substrates	U. series nvc codes
Breccia (Clent or Haffield)	The rock is identified by its characteristic breccia, consisting of unsorted, angular clasts set into a sand/mud matrix. The clasts consist of Pre-Cambrian rocks from the Malvern Hills and Shropshire, with subordinate clasts from Silurian and Devonian units.	
Edaphic	Of, produced by, or influenced by, the soil.	
Liassic	A blue-grey clayey limestone derived from marl deposited in the Lower Jurassic between 208 and 178 million years BP	
1. Pelosol 2. Calcareous pelosols	1. Non-alluvial clayey soils that crack deeply in dry seasons, but are slowly permeable when wet. They have a coarse blocky or prismatic structure. 2. With calcareous subsoil and no clay-enriched subsurface horizon.	
Stagnogleyic argillic brown earths	Soils with predominantly brownish or reddish subsoils and no prominent mottling or greyish colours (gleying) above 40 cm depth. They are developed mainly on permeable materials at elevations below about 300 m.O.D. Most are in agricultural use.	
Acidophilous	Soils (or vegetation) with a preference for slightly acidic conditions	
Cyperaceal	Of or pertaining to genus of rushy or sedgey plant species (genus: Cyperaceae).	
Hemicryptophyte	Partial rosette plants, in which the best-developed leaves form a basal rosette, but some leaves are also present on aerial stems (e.g. <i>Ajuga reptans</i> , bugle); or rosette plants, in which the leaves are confined to a rosette at the base of the aerial shoots (e.g. <i>Bellis perennis</i> , daisy).	
Lithomorphic	Lithomorphic Soils (including rendzinas) are shallow soils in which the only significant pedogenic process has been the formation of an organic or organic-enriched mineral. Often predominate over chalk or limestone on steep topography	