Half-hidden in the herbage-
A farmer's diary from Northern England

J. Rodwell

Introduction

The karstic landscape of Carboniferous Limestone in the Yorkshire Dales is one of the great beauties of Northern England, much valued for its scenery and wild-life and busy with tourists in the summer months. It is also a working landscape, its vegetation long shaped by farming and intimately associated with vernacular buildings and local culture. Yet it is not an easy place to make a livelihood from the land. The climate there is inhospitable. Winters are bitter and stormy with up to 50 days of observed snow or sleet (Manley 1940) and a long spring snow-lie. The growing season starts late and is shorter than in any other agro-climatic region of the country (Smith 1976). Growth normally begins in late April to early May but late frosts are frequent and, in the brief cloudy summer, temperatures can be below the critical mean for plant growth for more than half the time (Pigott 1956). The autumn is windy and very wet. Annual precipitation ranges from 900-1800mm annually (Climatological Atlas 1952) but the effect of this rainfall is modified through the physical and chemical properties of the soils. Away from the limestone exposures, the soils are frequently derived from head, fluvio-glacial material or most commonly till, which, with a substantial fine sand fraction, have little pore specie and show an early autumn return to field capacity with sometimes poor drainage below. Where the soil parent material is more free-draining, the profiles can be leached of any free calcium carbonate.

The limestone plateau has long been a region of pastoral farming, with sheep (Figure 1) and cattle grazed on the open hillsides or in enclosed pastures around the scattered farms in summer and sustained during the winter on hay cut from

Figure 1. Local breed of sheep in harsh winter weather in the Yorkshire Dales.

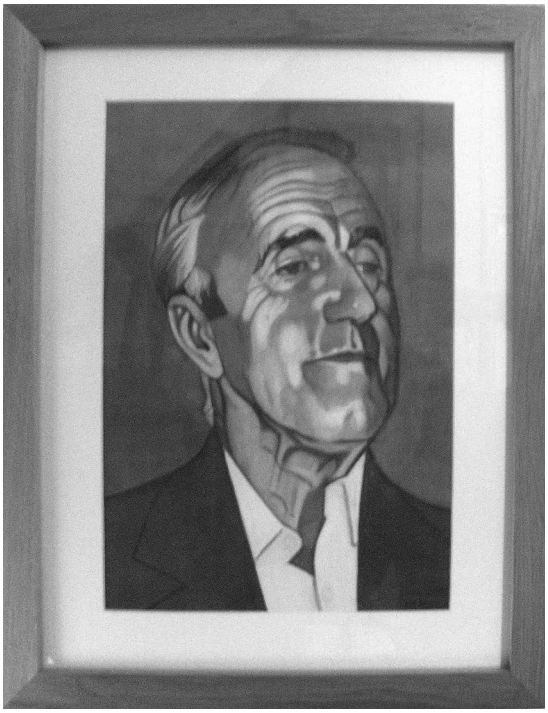

Figure 2. Portrait of Walter Umpleby by Sam Dalby.

meadows and stored in barns. In the few places where such traditional, low-input farming survives, we can still see something of the intimate relationship between the character of the vegetation and farm practice, how the composition and structure of the grasslands is determined by the annual cycle of operations and the kinds of interventions learned through generations of occupancy of particular places rich in cultural memory. Sometimes documentary records give an especially clear insight into how individuals have earned their living as well as bequeathed to us plant communities which, as phytosociologists, we value for their scientific interest and conservation value. Exceptionally, it is possible to analyse such records in a quantitative fashion to inform and question our assumptions about how such vegetation comes to be and how best we might sustain it for future generations to enjoy – and maybe also earn from it a living. This is an account of such a rich source of information, a record half-hidden among the herbage of the meadow that first catches our eye.

A particular place

New House Farm lies near the town of Malham, at 350m in the Yorkshire Dales of Northern England. It is a small farm of only 26ha, seven enclosed fields surrounding a stone farmhouse and modest outbuildings, surrounded by the pastures of the open hillside above. From January 1954 until December 1996, the farm was owned by Walter Umpleby who kept diaries of the life which he and wife led on the farm (Figure 2). On his retirement and sale of the property to the National Trust, a non-governmental organisation dedicated to the protection of landscape, buildings and culture, he summarised these diaries into succinct daily entries of what he had done and what had happened at New House Farm and thereabouts. Over 43 years, therefore, we have records of key farming activities detailing care of the stock, treatment of the land, as well as weather, maintenance work on the farm-

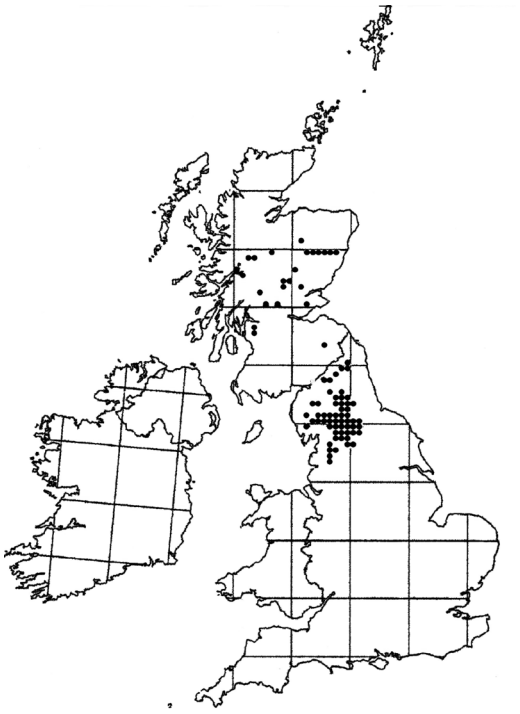

Figure 3. Total UK distribution of the Anthoxanthum-Geranium grassland on a 10x10km grid.

house, cooking and recreation. Very poignantly, the diaries also include a record of the final illness and death of Mrs Umpleby. In addition to the diaries, Mr Umpleby also gave two interviews to the National Trust from which notes were made.

Though these records are not unique for the region (other farmers for example, have noted key dates of their operations), they are unusually rich in their detail and, when I worked in the Unit of Vegetation Science at Lancaster University, with funding from the National Trust and Natural England, the state agency for nature conservation, my team was able to examine the diaries thoroughly and encode and analyse key farming activities (Rodwell et al. 2001). Of especial interest were the records year by year about the timing and duration of hay-making, stock movements and the pattern of manuring the meadows, because these questions are crucial for the sustainability of the meadow vegetation. An Access database was therefore prepared with numbered entries, locations and dates of activities, the kind of interventions and text-field comments, and these data form the basis of the results detailed below. First, however, we might ask why, for the phytosociologist, this kind of farming system is so interesting.

The vegetation of the Yorkshire Dales Hay Meadows

The most distinctive element of the vegetation in traditionally-managed hay meadows in the sub-montane zone of northern Britain is the *Anthoxanthum odoratum-Geranium sylvaticum* grassland (Rodwell 1992). This kind of vegetation is now largely confined to a few valley heads between 200 and 400m in the Yorkshire Dales, Lake District and County Durham, with some outliers further north in Northumberland and Scotland (see Figure 3). As well as surviving in hay meadows, it can also be seen on road verges, in graveyards, along river banks and in the margins of more intensive fields where generally similar environmental conditions

and treatments prevail. The most recent detailed estimate of the current extent of the *Anthoxanthum-Geranium* meadows through northern England was just 640ha (Cooch & Rodwell 1996).

Such vegetation probably originated centuries ago from the clearance of woodlands of the *Alnion incanae* Pawlowski 1928. Surviving stands of this woodland in the Yorkshire Dales landscape are very few but within open glades among the canopy of *Fraxinus excelsior*, *Sorbus aucuparia, Betula pubescens*, *Corylus avellana* and *Prunus padus,* we can see familiar plants of the hay-meadows growing in the dappled sunshine – *Geranium sylvaticum, Cirsium helenioides, Trollius europaeus, Geum rivale*, among a carpet of *Mercurialis perennis*, *Hyacinthoides non-scripta*, *Geranium robertianum, Dryopteris filix-mas* and *Athyrium filix-femina* (Rodwell 1991).

Within a wider European frame, the Yorkshire Dales hay meadows are clearly recognisable as part of the *Triseto flavescentis - Polygonion bistortae* Br.-Bl. et Tx ex Marschall 1947, an alliance of low-input meadows of well-drained, relatively fertile mineral soils through the sub-montane and montane zones of northern and central Europe. Traditionally, it has been included within the *Arrhenatheretalia elatioris* Tx. 1931, the order of European pastures and meadows of more fertile soils, but Mucina *et al.* (1993) took a narrower view of the alliance, retaining the *Polygono-Trisetion*, as they then called it, for the more strictly montane Central European meadows and placing this, along with two other alliances of high altitude grasslands, in the new order *Poo alpinae-Trisetalia* Ellmauer et Mucina 1993. The sub-montane meadows like our own *Anthoxanthum-Geranium* grassland they placed in the *Phyteumo-Trisetion flavescentis* Hundt et Passarge 1969), within the *Arrhenatheretalia.* This is the view summarised in Rodwell *et al.* (2002) and maintained in the new EuroVegChecklist (Mucina *et al*. in press).

An excellent overview of the Central European *Triseto-Polygonion* in its broader sense has been provided by Dierschke (1981), with subsequent additions from Theurillat (1992). Essentially, the alliance represents a montane counterpart to the unimproved lowland grasslands included within the *Arrhenatheretalia*, an altitudinal shift which is neatly shown in maps and graphs for the meadows of the Harz and Thuringia in Hundt (1964, 1966), summarised in Ellenberg (1988), and which, in Britain, we see most clearly in the contrast between the *Centaurea-Cynosurus* grassland (the major unimproved *Cynosurion* meadow with us) and the *Anthoxanthum-Geranium* grassland. Species of the *Molinio-Arrhenatheretea* form a consistent element of the vegetation with grasses such as *Festuca rubra, Poa pratensis* and *P. trivialis,* forbs like *Trifolium repens, T. pratense, Ranunculus acris, Cerastium fontanum, Plantago lanceolata, Leontodon hispidus, Achillea millefolium* and climbers such as *Vicia cracca* and *Lathyrus pratensis* more or less common throughout. *Trisetum flavescens,* the grass which gives its name to the alliance (and to many of the Continental counterparts of our own grassland of this type) is very frequent throughout but this is really an *Arrhenatheretalia* plant, widespread also at lower altitudes, and other species of this class that occur commonly in the *Triseto-Polygonion* are *Dactylis glomerata, Leucanthemum vulgare, Heracleum sphondylium, Lotus corniculatus, Taraxacum officinale* and *Veronica chamaedrys.* Other frequent plants occurring through the alliance that are of broader phytosociological affinity include *Agrostis capillaris, Anthoxanthum odoratum, Briza media* and *Luzula campestris.*

More especially characteristic of the *Triseto-Polygonion* alliance itself are the big ladies' mantles of the *Alchemilla vulgaris* agg. and also *Polygonum bistorta,* this latter being elsewhere in Europe as in Britain (Preston *et al*. 2002) not entirely confined to higher altitudes though often related to locally harsh climates (Ellenberg 1988). Apart from in the very easterly representatives of the alliance, these

grasslands are also characterised by *Geranium sylvaticum, Trollius europaeus* and *Avenula pubescens* and, except in the higher Alps, by *Festuca pratensis, Rumex acetosa, Holcus lanatus* and *Cynosurus cristatus. Sanguisorba officinalis* is virtually constant in our *Triseto-Polygonion* meadow though more patchy in this kind of vegetation elsewhere in Europe, while *Phyteuma spicatum*, occasional to frequent across much of the Continental *Triseto-Polygonion* is, in the UK, a Red Data Book plant now surviving in different habitats (Wigginton 1999, Wheeler & Hutchings 2002).

Dierschke (1981) recognised three major groups of meadows, ranked as sub-alliances within the *Triseto-Polygonion*, that can be related to regional climatic differences with changes in latitude and altitude across Europe. Within the sub-montane zone of northern and western Europe, the *Lathyro-Trisetenion* is the characteristic meadow type, with *Lathyrus linifolius, Poa chaixii, Anemone nemorosa, Crepis mollis, Alopecurus pratensis, Centaurea nigra, C. jacea* and *Campanula rotundifolia* preferential. Our own *Anthoxanthum-Geranium* upland hay meadows are very similar to one of the two major associations within this group, the *Geranio sylvatici-Trisetetum* Knapp 1951 which is essentially Sub-Atlantic in distribution. It has been described from the hills of the Ardennes in Belgium (Lambert 1965), the Rhineland mountains and Mittelgebirge of Germany (Büker 1942, Knapp 1951, Baeumer 1956, Wilmanns 1956, Boeker 1957, Oberdorfer 1957, Lötschert 1973), Austria (Mucina *et al*. 1993), the Czech Republic (Moravec *et al*. 1995, Chytry *et al*. 2007) and Hungary (Borhidi 2003). Essentially similar meadows have been described by Påhlsson *et al.* 1994 as the 5.2.2.4 *Geranium sylvaticum*-typ, including the Skogstorkenebb from Norway, the Metsänkurjenpolviniitty of Finland and the Skogsnävaängs of Sweden. At higher latitudes in Scandinavia and Greenland, some of the distinctive upland hay meadow plants appear in the 'Park Meadows' of the *Adenostylion alliariae* Br.-Bl. 1926 nom.conserv.propos., a shift we see in Britain in the similarity of some Scottish river-bank meadow vegetation to the high altitude mountain ledges of the *Luzula-Geum* community (Rodwell 1992; cf. Nordhagen 1928, 1936, 1943, Sjörs 1954, Böcher 1954).

The other main association in the *Lathyro-Trisetenion*, the *Meo-Festucetum* (R.Tx. 1937) J. & M. Bartsch 1940, is more characteristic of the Sub-Continental sub-montane zone occurring in central and southern Germany (Tüxen 1937, Bartsch & Bartsch 1940, Issler 1942, Oberforfer 1957, Hundt 1964, Klapp 1965, Trautman 1973, Vogel 1977), Poland (Matuszkiewicz 1982) and (as the *Meo-Cirsietum heterophyllae* Blažková 1991) in the Czech Republic (Moravec *et al*. 1995, Chytry *et al*. 2007). *Meum athamanticum* is the best diagnostic species for this association, with *Galium hercynicum* and *Arnica montana* less frequently preferential. Interestingly, a very few Lake District meadows and some Scottish streamside stands of vegetation of the *Anthoxanthum-Geranium* type have a striking abundance of *Meum* (Cooper & MacKintosh 1996), a Continental Northern plant and scarce with us.

The second sub-alliance, the *Campanulo-Trisetenion*, Dierschke (1981) retained for the *Triseto-Polygonion* meadows of the Jura and the Alps where there is a definitive shift to a high montane character. Essentially similar meadows occur at higher altitudes in seen in the Swiss and French Jura (Simeray 1976), further west in France, in the Cevennes (Braun-Blanquet 1915), Auvergne (Luquet 1926) and Massif Central (Schaminée 1993). These last meadows I was privileged to see together with Joop Schaminée and some PKN members on an excursion to the Mont du Forêt in 1996, when we heard how traditional farming had been so important in their sustainability also.

In Rodwell (1992), two sub-communities of the *Anthoxanthum-Geranium* grassland were characterised from meadows, one showing much lower species alpha- and

beta-diversity, in particular a reduction in plants more sensitive to increased fertility and an increased frequency of *Lolium perenne, Phleum pratense* and *Bromus hordeaceus* spp. *hordeaceus,* in other words a shift towards a more generalised *Cynosurion* flora. On some farms, this change is known to be related to temporary ploughing for the cultivation of potatoes during the Second World War. A third subcommunity (initially distinguished without relevés but later studied by Pacha 2004) was recognised from habitats like road verges which are mown for neatness and road safety but largely ungrazed.

In the UK, the traditional treatment that has sustained the vegetation of upland hay meadows has involved winter and spring grazing, a closure in early May with removal of stock to the open hill pastures, a single mowing from late June onwards when periods of fine weather permit, and grazing of the meadow regrowth or aftermath in the late summer and autumn (Bradshaw 1962, Rodwell 1992). In the past, mixed stock rearing was the norm, though, more recently, sheep have predominated in the Pennines and Lake District. Fertilising, apart from the dung and urine of the grazing stock, has been with one (sometimes two) dressings of farmyard manure each year, with occasional liming and additions of superphosphate. Walter Umpleby's diaries enable us to have a close look at the particular conditions under which the meadows had been managed there and perhaps to question some assumptions about how they might be sustained under nature conservation management.

The farming life at New House

Adjacent to the farmhouse, New House has 4 meadows, totalling just over 8ha in extent. These are recognisably of the *Anthoxanthum-Geranium* type though, like all such meadows, they show local idiosyncracies of composition reflecting variations in soil conditions and treatment. There are also 3 enclosed pastures, totalling 18ha, adjacent to the farm which, as is usual on such traditional farms, have grasslands of the *Cynosurion cristatae* Tx. 1947, fertilised by dung. Mr Umpleby also had rights of common grazing on the open hills, a usual arrangement to allow summer-grazing of sheep while the hay meadows were closed for the herbage to grow, but apparently he never exercised these, his stock numbers being relatively small. Such open pastures are typically of low productivity grasslands of the *Seslerion caeruleae* Br.-Bl. In Br.-Bl. et Jenny 1926 grasslands on the limestone rendzina soils and of the *Violion caninae* Schwickerath 1944 on more acidic soils derived from superficial deposits or shales which cap the limestone.

The animals

As well as hens, ducks and, in early years, a pig, slaughtered each year for home use, Mr Umpleby kept cattle and sheep at New House. In his early years there, he kept Dairy Shorthorns and then Friesian cattle for milking. Later he switched to Hereford Crosses, Simenthals and Limousins for beef production but the number of animals was always small – only 18 in later years. In spring and summer the cattle were grazed on the *Cynosurion* pastures and, only after the hay cut were they moved onto the meadows to eat the aftermath, called 'fogg' or 'foggage' locally and, in the rainy autumn, quite considerable in amount. Traditionally, on such farms, the cattle were kept in a cow-house over the winter, tied by the neck in stalls and fed on the hay. Calving occurred in late May and June and the calves were kept for up to 18 months before being sold on.

Sheep were more numerous and, when the farm was sold to the National Trust, there were 30 Masham ewes, a reduction from Mr Umpleby's earlier flock of 40 and a change of breed from the Suffolks he kept earlier. The sheep were 'tupped' or mated with the ram on the pastures and the ewes put in the meadows for lambing in the spring, then moved onto the pastures for the summer.

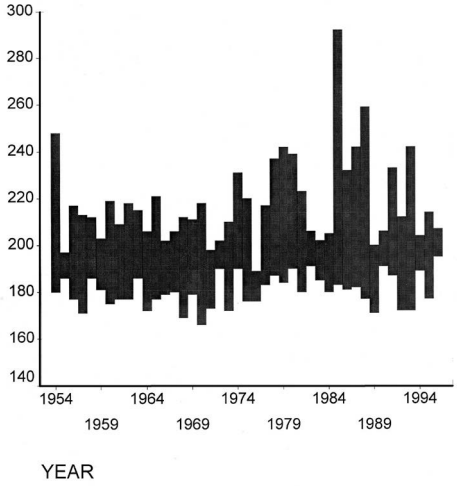

Figure 4. Duration of hay-timing shown as days of the year at New House Farm 1954-1996

Meadow management

Mt Umpleby took his animals off the meadows between 1 and 12 May every year, shutting up the fields in the same order each time. Although spring starts late in this region, temperatures rise quite quickly in May and the herbage grows so rapidly that fields may be ready for mowing in less than two months. Most of the herbaceous plants are rosette hemicryptophytes (themselves half-hidden until spring) which quickly put up flowering shoots; and some important meadow perennials like *Geranium sylvaticum* have very substantial rhizomes with substantial food stores which can be quickly mobilised as soils warm up. The hay is cut 'when it is ready' as the farmers say, but needs three or four warm and sunny days to dry in the fields before being baled and carted off to the barns for storage. And, in the unpredictable climate of the region, the start and end of 'hay-timing' as it is called locally can be very variable, long gaps sometimes occurring between cutting one field and another. From the diaries we can see that, during his 45 years of farming at New House (Figure 4), Mr Umpleby's earliest start date was 15 June (1970), his latest 13 July (1996). The earliest end-date was 7 July (1976), the latest 19 October (1985). The shortest completion time for hay making was 12 days (1976) and the longest 85 days (1985). The actual time spent cutting and carting the hay varied from 13-48 days.

In so far as the period of study overlaps, hay-timing records for five other farms scattered over 50 kilometres in the region (Smith & Jones 1991) show that the shortest and longest hay-making periods at New House are also among the shortest and longest elsewhere, reflecting the generally similar regional climate. These authors also saw a statistically significant reduction in the duration of hay-timing of between 35-61%, which they attributed to mechanisation – a move from mowing by scythe to mechanical cutting. We saw no such significant change at New House.

Mr Umpleby reckoned on getting 240 bales of hay/ha or roughly 4 tonnes/ha, calculating at 60 bales = 1 tonne, a generally accepted average. This would have given him a total yield of around 2000 bales (or 33 tonnes total) in a good year. The dairies show that there were exceptionally between 150 and 400 bales left over at the end of the winter. A drought year left none spare at all and, although

hay was the mainstay of winter feed, records show that he also fed some concentrates and sheep cake, so the farm was not always internally subsistent.

Dung and urine was added to the soils from the animals as they grazed but fertility of the meadows in these kinds of traditional farms was maintained mainly by using dung from the cow-shed mixed with bought-in straw that was used for bedding for the animals. This 'rough muck' was spread on the fields from February to May each year, the meadows being treated in the same order as they were shut up and mown. Spare muck was also spread after hay-timing and, if there was any spare, sometimes in the winter. Mr Umpleby expressed concern that his meadows were not 'in such good heart' in recent years, when he had fewer stock.

Liquid manure was also occasionally spread and sometimes chemical fertiliser. Also very important, according to traditional farmers, was the periodic application of calcium superphosphate, in the form of 'basic slag', a waste-product from steel-making, and Mr Umpleby did this at New House most years until the early 1980s. Lime was also applied to most of the meadows and pastures until this time. This is essential because, with the high rainfall in the region, even the soils derived from the underlying limestone can become surface-leached, reducing their fertility.

After Mr Umpleby

After Mr Umpleby left New House Farm in 1994, the National Trust was concerned to continue, as far as possible, the kind of farming he practiced there and so sustain the diversity and interest of the meadow vegetation. And, inspired by the record of the diary, we were able, through the MSc programme at Lancaster University, to investigate further the productivity of the meadows there (Taylor 2004). During the 2004 growing season, 3 randomly located plots were situated in each of the four meadows and, each week between the closing of the meadows and hay-timing, the herbage was cut from a separate 50x50cm plot (Figure 5). The herbage was sorted into dicotyledons and monocotyledons (mainly grasses) and the samples weighed fresh and after gentle oven-drying, General Linear Modelling being used to assess variation within and between the meadows and changes through time. There was much significant within-meadow variation in productivity, a typical reflection of the varying character of soils in traditionally managed fields where chemical fertilising has not evened out local differences. And significant between-meadow variation might be the result of the staggered shut-up times or variations in manure input.

Results also showed that the weekly increases in fresh and dry weight were statistically significant (at a probability level of 95%). In other words, the longer the shut-up period, the more hay that could be produced. However, this says nothing, farmers like Mr Umpleby have warned us, about the changing quality of the herbage as fodder during the growing season. And it does not take account of the fact that variable summer weather means the farmer has to take a gamble between the prospect of increasing productivity, week by week, and the need for some days of warm sunny conditions to dry the hay.

When the hay was cut in 2004, after 10 weeks of growth from closure of the first of the meadows, the productivity could be scaled up from the mean dry matter productivity values to 3.4 tonnes per hectare, or 27 tonnes total for the farm, somewhat less than a good year from the diary. In another study at a traditional Yorkshire Dales farm at the lower altitude of 270m (Edwards 1999), a similar destructive sampling and scaling up gave productivity figures of a mean 6.5 tonnes/ha. Even the lower figures are a challenge to the idea that traditional farming of this kind is unproductive. In all the New House meadows, the dry weight of monocotyledons always exceeded that of dicotyledons at the final harvest, again echoing the

Figure 5. A sample plot with destructive harvesting of meadow herbage, New House Farm in the background.

concern of traditional farmers that grasses, with their higher fibre content, should form the bulk of the winter feed.

The sustainability of traditional meadows depends on manuring to maintain the fertility of the soils and differences in the rate of manuring are known to over-ride the effects of other environmental factors in such meadows (Smith & Jones 1991). And, indeed, rough comparisons between the scaled-up productivity of the New House meadows and the application of rough muck in the season of the study show a proportionality: 4.5 tonnes/ha hay with 25 tonnes/ha manure, 3.3 tonnes/ha with 13 tonnes/ha manure, 3.2 tonnes/ha hay with 17 tonnes/ha manure and 2.6 tonnes/ha hay with 10 tonnes/ha manure.

The continuing threats to mountain hay meadows

Almost everywhere across Europe, hay meadows of the type found at New House Farm have declined very substantially over the past decades (by an estimated 95% in the UK) and are under continuing threat (Rodwell *et al*. 2013). They are recognised under Annex 1 of the Habitats Directive in Priority Habitat 6520 Mountain hay meadows (CEC 2004) and New House forms part of Site of Conservation Interest notified by the UK government.

Particularly in central and eastern Europe, abandonment of grasslands is a major threat with a resurgence of scrub vegetation but, in the UK, as across much of

western Europe for the past century, it is agricultural 'improvement' of the soils by the application of chemical fertilisers and slurry (liquid cattle dung) that has had the major impact (Figure 6). This is known to affect the balance between grasses and dicotyledons (Jones 1984) and to diminish species-richness (Smith 1988, 1994), even where other elements of traditional management are retained. Very often, however, such fertilising has been accompanied by a shift away from hay-making towards cropping for silage, taking two, sometimes three cuts. In many cases, meadows have also been ploughed or harrowed and sown with mixtures of productive forage grasses.

Conservation management of the *Anthoxanthum-Geranium* meadows in the UK forbids the application of any chemical fertilisers but many practitioners are also wary of using cattle dung, despite what we know about its necessity from farms like New House. Of course, rates of application of dung under traditional regimes varied considerably (Simpson & Jefferson 1996, Rodwell et al. 2007) but they seem to have been more than, and less damaging than, either current conservation management recommends (Croft & Jefferson 1999) and than some experimentation suggests is appropriate (Smith 2005). The addition of chemical fertilisers in small amounts is not unknown from traditional farms, as we see at New House, and indeed it may be that naturally levels of phosphate in the soils (Critchley *et al*. 2002) require occasional upgrade. In the UK, the use of superphosphate and lime is also often forbidden in nature management, despite what we know from traditional farm practice.

Experimentation has shown that the timing and intensity of grazing are important in controlling the character of these hay meadows though modest variation can maintain essentially the same vegetation over a four-year period (Smith & Rushton 1994). Mowing times also have an effect: despite the interest in the colourful forbs in this vegetation, by traditional hay-time it is, as we have seen, usually grasses that predominate by dry weight (Edwards 2000, Taylor 2004) and late cutting has been shown to favour certain grass species (Smith *et al*. 1966*a*). The timing of the cut also affects which species contribute ripe seed in the drying hay that is able to enter the soil seed bank: the phenology of the *Anthoxanthum-Geranium* meadow is a rich and complex process in itself (Cooper *et al*. 1997) and a midsummer cut is most productive in this respect (Smith et al. 1996*b*). However, whatever the aesthetic virtues of the colourful flora, we still cannot deny that it is a by-product of a severely practical system intended to provide herbage to keep animals alive through the winter

It is clear from farm diaries such as that of Walter Umpleby that differences in weather from year to year have a marked influence on the timing and duration of hay-making and subsequent grazing of the aftermath, as well as on the size and quality of the crop. Such a flexible responsiveness, together with the spatial diversity of unimproved soils across the enclosed meadows, has contributed greatly to the local distinctiveness of meadows from farm to farm, even from field to field, and year to year. On farms where high quality hay meadows survive, inflexible application of agri-environment regulations, with fixed dates for hay-cutting and a narrow view of the need for maintaining soil fertility and hay productivity and quality, can therefore themselves be potentially damaging to the species-richness and diversity of the vegetation and the intimate inter-relationship between wildlife quality and agricultural value. Though most hay meadows of the New House type were included within the then UK Environmentally Sensitive Area schemes by the late 1980s (Jefferson 2005), there seems to have been little progress towards restoration of any species-richness within semi-improved grasslands within the Pennine and Lake district landscapes (Critchley *et al.* 2004). The attempted experimental restoration of *Anthoxanthum-Geranium* grassland in the Yorkshire Dales has been documented by Smith *et al*. (1996*c*, 2000) and Smith (1997). Here swards approximating to

this type were produced mainly by a combination of spring and autumn grazing, later cutting dates and the addition of seed, with or without chemical fertiliser.

An essential distinguishing feature of the environment that sustains meadows of the New House type is a harsh climate with cold winters and a short growing season, so a global climate shift towards milder winters and an earlier spring might be expected to threaten some of their distinctive flora. One of the most striking species, for example, is *Geranium sylvaticum* which is a Northern Montane plant with a striking lower altitudinal cut-off to its distribution in the UK. This may be partly related to its need for seed vernalisation before germination (Hill 2002), but also important may be a need for low winter temperatures to prevent respiratory rundown of its carbohydrate and protein resources in the bulky rhizome, a reserve which it is able to draw on quickly after the temperature rises above the growing point in early May. Loss of a sub-montane floristic element would leave the *Triseto-Polygonion* meadows with a floristic composition resembling a *Cynosurion* grassland, effectively the same shift as follows on modest fertilisation of the soils.

Acknowledgements

I am grateful to the National Trust and Natural England for financial support for the work on Walter Umpleby's diary, and to their staff for further information about the property, to Liz Hayes and Julian Dring for their work on developing the New House Farm database and analysing the data, and to Jennifer Newton and Andrew Edwards for their MSc projects at Lancaster University. I was myself Professor of Plant Ecology at Lancaster during the time of the work.

Figure 6. In the foreground, a meadow treated for ten years with slurry, now species-poor Cynosurion, compared with a traditionally managed meadow behind.

Abstract

An unusually rich farmer's diary with daily entries through the period 1954-1996 provides a detailed insight into life on a traditional farm in the Pennine hills of Northern England. This is the heartland of the British examples of *Triseto-Polygonion* meadows, now one of the scarcest and most threatened types of grasslands in the UK. In the harsh sub-montane climate, these meadows have traditionally been fertilised by animal dung, providing a single cut of hay in mid-summer and grazing for sheep and cattle before and after the hay-making period. Together with enclosed *Cynosurion* pastures and open hill grazings of *Violion* and *Seslerion* grasslands, they provide a highly distinctive element of the local landscape, accompanied by vernacular buildings and a long lineage of place names reflecting settlement, topography and land-use.

This paper describes the floristic composition of the British *Triseto-Polygonion* meadows and sets them in the wider European context of low-input meadows of free-draining, relatively fertile minerals soils through the sub-montane and montane zones of northern and central Europe. It outlines the annual pattern of farming activity and, using the diary, provides details of stock management, the pattern of hay-making from year to year, including hay-cut times and manuring in this particular place. Field investigations after the period of the diary supplement our understanding of the productivity of the meadows and, with the details of actual farm life, challenge some of the common assumptions underlying the conservation management of these hay-meadows. Thoughtful treatment will be essential if such farms are to be a realistic agricultural operation as well as the locus of interest for biodiversity in such networks as Natura 2000.

Een speld in de hooiberg

Een buitengewoon dagboek van een boer, met dagelijkse aantekeningen uit de periode 1954-1996, geeft een gedetailleerd inzicht in het leven op een traditionele boerderij in de Pennine heuvels in Noord Engeland. Het is het kerngebied van het *Triseto-Polygonion*-hooiland, een van de zeldzaamste en meest bedreigde graslandtypen in Groot Brittannië. Deze hooilanden werden in dit gure, submontane klimaat traditioneel jaarlijks bestrooid met ruige stalmest om er in het midden van de zomer een snit hooi vanaf te kunnen halen met voor- en nabeweiding. Samen met ommuurde *Cynosurion*-weilanden en de open, beweide heuvels met *Violion*- en *Seslerion*-grasland vormen ze een karakteristiek geheel in het lokale landschap, vergezeld door streekeigen gebouwen en een lange rij plaatsnamen die refereren aan vestiging, topografie en landgebruik.

Dit artikel beschrijft de floristische samenstelling van de Britse *Triseto-Polygonion*-hooilanden en plaatst ze in een bredere Europese context van de extensieve, *low input*-hooilanden op relatief vruchtbare bodems in de submontane en montane zones in Noor en Centraal Europa. Het schetst het jaarlijkse patroon van het beheer van het boerenland en geeft met behulp van het dagboek inzicht in de omgang met het vee, de maaidata en de hooiperiode van jaar tot jaar, en de bemesting op deze bijzondere plek. Veldonderzoek na het overleggen van het dagboek, leidde, samen met het inzicht in het actuele boerenleven, tot meer inzicht in de productiviteit van deze hooilanden. Op basis daarvan worden kritische vragen gesteld over de gangbare aannames die ten grondslag liggen aan het natuurbeheer in deze hooilanden. Een goed doordacht beheer is essentieel als dergelijke traditionele landbouwpraktijken weer operationeel worden in het belang van de biodiversiteit in Natura 2000-gebieden.

Literature

Baeumer, K. (1956). Verbreitung und Vergesellschaftung des Glatthares (*Ar rhenatherum elatius*) unde Goldhafers (*Trisetum flavescens*) im nördlichen Rheinland. Decheniana 3, 1-77.

Bartsch, J. & Bartsch, M. (1940). Vegetationskunde des Schwarzwaldes. Pflanzensoziologie, 4.

Böcher, T.W. (1954). Oceanic and continental vegetation complexes in south-west Greenland. Meddelelser Grønland, 148, 82-418.

Boeker, P. (1957). Basenversorgung und Humusgehalte von Böden der Pflanzengesellschaften des Grünlandes. Decheniana 4.

Borhidi, A. (2003). Magyarország növenytársulásai. Budapest: Akadémiai Kiadó.

Braun-Blanquet, J. (1915). Les Cevennes Méridionales. Geneva.

Bradshaw, M.E. (1962). The distribution and status of five species of the *Alchemilla vulgaris* L. aggregate in Upper Teesdale. Journal of Ecology, 50, 681-706.

Buker, R. (1942). Beiträge zur Vegetationskunde des südwestfälischen Berglandes. Beih. Bot. Cbl. 56, 452-558.

CEC (2003). Council Directive 92/43/EEC of 21 May 1992 on the onservation of natural habitats and of wild fauna and flora. Brussels: European Commission.

Chytry, M. editor (2007). Vegetation of the Czech Republic, 1. Grassland and Heathland Vegetation. Prague: Academia.

Climatological Atlas of the British Isles (1952). London: Meteorological office.

Cooch, S. & Rodwell, J.S. (1996). Preliminary study of key issues in relation to northern hay meadows. Lancaster: Unit of Vegetation Science report to WWF (UK).

Cooper, E.A & Mackintosh, J. (1996). NVC Review of Scottish grassland Surveys. Lancaster: Unit of Vegetation Science Report to Scottish Natural Heritage.

Cooper, E.A., Cooch, S. & Rodwell, J.S. (1997). Northern Hay Meadows. Lancaster: Unit of Vegetation Science report to WWF (UK).

Critchley, C.N.R., Fowbert, J.A., Wright, B. & Parkin, A.B. (2004) Monitoring of hay meadows in Pennine Dales ESA (MA01005). http://www.defra.gov.uk/research/ project_data.

Croft, A. & Jefferson, R.G. (1999). The Lowland Grassland Management Handbook. 2nd edition. Peterborough: English Nature & The Wildlife Trusts.

Dierschke, H. (1981). Syntaxonomische gliederung der Bergwiesen Mitteleuropas (*Polygono-Trisetion*). Berichte der Internationalen Symposien der Internationalen Vereinigung für Vegetationskunde 1981, 311-341.

Edwards, A. (1999). The Productivity of Traditionally Managed Hay Meadows in the Pennines. MRes thesis, Lancaster University

Ellenberg, H. (1988). Vegetation Ecology of Central Europe. Cambridge: Cambridge University Press.

Hill, P. (2001). The ecology of *Geranium sylvaticum* with special reference to germination characteristics. Lancaster University BSc dissertation.

Hundt, R. (1964). Die Bergwiesen des Harzes, Thüringer Waldes und Erzgebirges. Pflanzensoziologie, 14, 1-264.

Hundt, R. (1966). Ökologische-geobotanische Untersuchungen an Pflanzen der mitteleuropäischen Wiesenvegetation. Botanische Studien, 16, 1-176.

Issler, E. (1942). Vegetationskunde der Vogesen. Pflanzensoziologie, 5.

Jefferson, R.G. (2005). The conservation management of upland hay meadows in Britain: a review. Grass & Forage Science, 60, 322-331.

Jones, R.M. (1984). The vegetation of upland hay-meadows in the north of England with experiments into the causes of diversity. Lancaster University PhD thesis.

Klapp, E. (1965). *Grunlandvegetation und Standort – nach Beispielen aus West-, Mittel- under Suddeutschland.* Berlin und Hamburg.

Knapp, E. (1951). Uber Pflanzengesellschaften der Wiesen im Vogelsberge. Lauterbach Sammlungen 6, 1-8.

Lambert , J. (1965). La Prairie à colchiques: une des plus intéressantes formation végétales d'Ardenne, en voise de disparition. Netherlands Journal of Agricultural science, 13, 129-142.
Lötschert, W. (1973). Pflanzengesellschaften im Rhein-, Main- und Taunus-gebiet. Jahrb. Nass. Ver. Naturk. 102, 16-68.
Luquet, A. (1926). Les associations végétales du Massif des Monts-Dores.
Manley, G. (1936). The climate of the Northern Pennines. Quarterly Journal of the Royal Meteorological Society, 61, 405-410.
Matuszkiewicz, W. (1984). Przewodnik do Oznaczania Zbiorowisk Roślinnych Polski. Warsaw: Państwowe Wydawnictwo Naukowe.
Moravec, J. (1995). Rostlinná Společenstva České Republicky. Pruhonice: Instute of Botany.
Mucina, L., Grabherr, G. & Ellmauer, T. (1993). Die Pflanzengesellschaften Österreichs, Teil III. Jena: Gustav Fischer Verlag.
Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Raus, T., , Čarni, A., Šumberová, K., Willner, W., Dengler, J., Gavilán García, R., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko D., Pallas, J., Daniëls, F.J.A., Bergmeier, E., Santos Guerra, A., Ermakov, N., Valachovič, M., Schaminée, J.H.J., Lysenko, T., Didukh, Y.P., Pignatti, S., Rodwell, J.S., Capelo, J., Weber, H.E., Solomeshch, A., Dimopoulos, P., Aguiar, C., Hennekens, S.M. & Tichý, L. (submitted in June 2014, in revision since 23 December 2014). Vegetation of Europe: Hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science.*
Nordhagen, R. (1928). Die Vegetation und Flora des Sylenegebiets. Oslo.
Nordhagen, R. (1936). Versuch einer Einteilung der supalpinen-alpinen Vegetation Norwegens. Bergen Museums Årbok 7, 1-88.
Nordhagen, R. (1943). Sikilsdalen og Norges Fjllbeiter. Bergens Museums Skrifter 22. Bergen: Griegs.
Oberdorfer, E. (1957). Suddeutsche Pflanzengesellschaften. Pflanzensoziologie 10: 1-564.
Pacha, M.J. (2004). Fragmentation of northern hay meadows and populations of *Geranium sylvaticum* in the Yorkshire Dales National Park. Lancaster University PhD thesis.
Pählsson, L. (1994). Vegetationstype I Norden. Copenhagen: Nordisk Ministeraad.
Pigott, C.D. (1956). The vegetation of Upper Teesdale in the north Pennines. Journal of Ecology, 44, 545-586.
Preston, C.D., Pearman, D.A. & Dines, T.D. editors (2002). New Atlas of the British & Irish Flora. Oxford: Oxford University Press.
Rodwell, J.S. editor (1991). British Plant Communities. Volume 1. Woodlands & Scrub. Cambridge: Cambridge University Press.
Rodwell, J.S. editor (1992). British Plant Communities. Volume 3. Grasslands and montane communities. Cambridge: Cambridge University Press.
Rodwell, J.S., Hayes, E.A. & Dring, J. (2001). Walter Umpleby's Diary: a Database for New house Farm. Lancaster: Unit of Vegetation Science report to the National Trust and English Nature.
Rodwell, J.S., Schaminee, J.H.J., Mucina, L., Pignatti, S., Dring, J. & Moss, D. (2002). The Diversity of European Vegetation. Wageningen: National reference centre for Agriculture, Nature & Fisheries.
Rodwell, J.S., Morgan, V., Jefferson, R.G. & Moss, D. (2007). The European context of British Lowland Grasslands. Peterborough: Natural England.
Rodwell, J.S., Janssen, J., Gubbay, S. & Schaminée, J.H.J. (2013). *Red List Assessment of European Habitat Types, a Feasibility Study. Report to DG (Environment)*. Alterra, Wageningen.
Schaminée, J.H.J. (1993). Subalpine heathlands and adjacent plant communities of the Monts du Forez (Massif central, France). PhD thesis, University of Nijmegen.

Simeray, J. (1996). Essaie d'interpretation des groupements végétaux de la region de Saint-Claude en vue d'une synthèse cartographique. Thèse Université Besançon.

Simpson, N.A. & Jefferson, R.G. (1996). The use of farmyard manure on semi-natural (meadow) grassland. English Nature Research Reports No 150. Peterborough: English Nature.

Sjors, H. (1954). Sletterangar: grangärde Finnmark. Acta Phytogeographica Suecica, 34, 1-135.

Smith, L.P. (1976). The Agricultural Climate of England and Wales. Ministry of Agriculture, Fisheries & Food Technical Bulletin 35. London: HMSO.

Smith, R.S. (1988). Farming and the conservation of traditional meadowland in the Pennine dales Environmentall Sensitive Area. In Usher, M.B. & Thompson, D.B.A. (editors) Ecological Change in the Uplands. British Ecological Society Special Publication No 7. Oxford: Blackwell Scientific Publications & British Ecological Society.

Smith, R.S. (1994). Effects of fertilisers on plant species composition and conservation interest of UK grassland. In Haggar, R.J. & Peel, S. (editors) Grassland Management and nature Conservation. Occasional Symposium No 28 British Grassland Society, pp. 64-73. Reading: British Grassland Society.

Smith, R.S. (1997). Upland meadow grasslands in the Pennine Dales Environmentally Sensitive Area. In Sheldrick, R.D. (editor) Grassland Management in the Environmentally Sensitive Areas. Occasional Symposium No 3 British Grassland Society, pp. 80-90. Reading: British Grassland Society.

Smith, R.S. (2005). Ecological mechanisms affecting the restoration of diversity in agriculturally improved meadow grassland (Defra Project BD1439). http://www.defra.gov.uk/science/project_data/DocumentLibrary/BD1439/BD1439_2750_FRP.doc.

Smith, R.S. & Jones, L. (1991). The phenology of mesotrophic grassland in the Pennine Dales, Northern England: historic hay cutting dates, vegetation variation and plant species phonologies. Journal of Applied Ecology, 28, 42-59.

Smith, R.S. & Rushton, S.P. (1994). The effects of grazing management on the vegetation of mesotrophic (meadow) grassland in Northern England. Journal of Applied Ecology, 31, 13-24.

Smith, R.S., Buckingham, H., Bullard, M.J., Shiel, R.S. & Younger, A. (1966a). The conservation management of mesotrophic (meadow) grassland in Northern England. I. Effects of grazing, cutting date and fertiliser on the vegetation of a traditionally managed sward. Grass and Forage Science, 51, 278-291.

Smith, R.S., Pullan, S. & Shiel, R.S. (1966b). Seed shed in the making of hay from mesotrophic grassland in a field in northern England: effects of hay cut date, grazing and fertiliser in a split-split-plot experiment. Journal of Applied Ecology, 33, 833-41.

Smith, R.S., Corkhill, P., Shiel, R.S. & Millward, D. (1966c). The conservation management of mesotrophic (meadow) grassland in Northern England II. Effects of grazing, cutting date, fertiliser and seed application on the vegetation of an agriculturally improved sward. Grass and Forage Science, 51, 292-305.

Smith, R.S., SHiel, R.S., Millward, D. & Corkhill, P. (2000). The interactive effects of management on the productivity and plant community structure of an upland meadow: an 8-year field trial. Journal of Applied Ecology, 37, 51-64.

Taylor, J. (2004). *Productivity of Traditional Pennine Hay Meadows.* Lancaster University MSc thesis.

Theurillat, J-P. (1992) Les Prairies à Trisetum flavescens (L.) P. Beauv. (*Triseto-Polygonion*) dans la région d'Aletsch (Valais) et en Suisse. Candollea, 47, 319-56.

Trautmann, W, (1973). Vegetationkarte des Bundesrepublik Deutschland 1:200 000 – Potentielle naturliche Vegetation – Blatt CC5502. Schriftenr. F. Vegetationskd, 6, 7-172.

Tüxen, R. (1937). Die Pflanzengesellschaften Nordwestdeutschlands. Mitteilungen der Floristisch-soziologischen Arbeitsgemeinschaft, 3, 1-170.
Vogel, A. (1977). Die Wiesengesellschaften des Westharzes. Gottingen University Diplome.
Wheeler B.R. & Hutchings, M.J. (2002). *Phyteuma spicatum* L. Biological flora of the British Isles. *Journal of Ecology,* 90, 581-591.
Wigginton, M.J. editor (1999). British Red Data Books. 1. Vascular Plants. 3rd edition. Peterborough: Joint Nature Conservation Committee.
Wilmanns, O. (1956). Die Pflanzengesellschaften der Äcker uner des Wirtschafts grunlandes auf der Reutlinger Alb. Beitr. Naturkdl. Forsch. SW-Dtschl. 15, 30-51.

Contactgegevens:
John Rodwell
E-mail: johnrodwell@tiscali.co.uk