Conserving socio-ecological landscapes: An analysis of traditional and responsive management practices for floodplain meadows in England

Journal Item

Conserving socio-ecological landscapes; an analysis of traditional and responsive management practices for floodplain meadows in England

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Abstract

Contemporary practice in the conservation of socio-ecological landscapes draws on both a model of responsive management, and also on ideas about historic management. This study considered what evidence might exist for the exercise of these approaches to management in the conservation of floodplain meadows in England, in order to inform understanding and knowledge of conservation management and assessment practice.

Evidence for a model of responsive management was limited, with managing stakeholders often alternating between this model and an alternative approach, called here the 'traditional management approach', based on ideas, narratives and prescriptions of long-established land management practices. Limited monitoring and assessment appeared to undermine the former model, whilst uncertainty over past long-standing management practices undermined the latter. As a result of the relative power of conservation actors over farmers delivering site management, and their framings of meadows as 'natural' spaces, management tended to oscillate between aspects of these two approaches in a sometimes inconsistent manner.

Conservation managers should consider the past motivating drivers and management practices that created the landscapes they wish to conserve, and bear in mind that these are necessarily implicated in aspects of the contemporary landscape value that they wish to maintain. They should ensure that assessment activity captures a broad range of indicators of site value and condition, not only biological composition, and also record data on site management operations in order to ensure management effectiveness.

Highlights

- management models for socio-ecological landscapes can be inconsistently applied
- assessments can be too partial to assist responsive management decision-making
- normative ideas about the value of nature influence interpretation of evidence
- conservation management tends toward a historical-contemporary hybrid

Keywords

Conservation models, traditional, responsive, adaptive, historical management, assessment, stakeholders, conservation.

1 Introduction

Globally, many conservation stakeholders responsible for the management of nature protected areas commonly hold to a model of responsive or adaptive management as a valid approach for a wide range of systems, from coastal barrier islands (Carruthers et al, 2013) to fisheries (Uyachiaoco et al 2004) and European grasslands (Crofts and Jefferson, 1999; Robertson and Jefferson, 2000; Soane, 2012). This model relies on a cyclical process of monitoring and assessment to follow evolution of both system condition and management operations, in order to inform subsequent management decisions (Greenwood and Robinson, 2006).

Although widely practiced, researchers have critiqued the nature and quality of much conservation monitoring that is intended to inform responsive management in a range of contexts, from European derelict landscapes to African tropical forests (Usher, 1989; Sheil, 2001; Yoccoz et al, 2001; Sutherland et al, 2004; Legg and Nagy, 2006). Debates revolve around not only clarity of survey design, aims and objectives, but also the relevance of much biodiversity monitoring to management decision-making (Danielsen et al, 2005), as well as more fundamental questions of what kind of data should be collected and the utility of expert versus experiential data (Fazey et al, 2006). Some authors have noted the need to close and tighten the adaptive management cycle (Uychiaoco et al., 2005; Carruthers et al., 2013), although the impacts of management operations are not always well understood (Crofts and Jefferson, 1999; Freese et al, 2014).

Around the world, for highly valued socio-ecological landscapes (co-produced by the interaction of biophysical and social processes) that were created through historical agricultural use, researchers emphasise the role of long-standing land-management practices in maintaining such landscapes (Bignal and McCracken, 1996; Losvik, 2003; Bezak and Halada, 2010; Fischer et al, 2012; Birge and Herzon, 2014) and the threat of abandonment and loss of associated 'traditional ecological knowledge' (Prince et al, 2012; Scanga and Leopold, 2012; Babai and Molnar, 2014; Joyce, 2014). An alternative conservation management approach, called here the 'traditional management approach', is also therefore commonly in evidence for socio-ecological landscapes. This refers to contemporary conservation management practice based, accurately or inaccurately, on present understandings of past historical management practices. These contemporary 'traditional' management practices may or may not be the same as actual past practices. True past management practices on socio-ecological landscapes based on agriculture may also have been responsive in a range of ways or a hybrid of long-standing and newer practices (Verzijl and Guerrero Quispe, 2013; Fernald et al, 2015). However, where based on firmly held views about past practices, contemporary 'traditional' management, could preclude scope to manage landscapes responsively (Dinnie et al, 2015).

Under this model, a good understanding of past practices is required over an extended period, which may not be available. Also, each landscape constitutes a unique assemblage, whose materiality and management have varied over time and space (Sheail, 1986; Crofts and Jefferson, 1999). As Harris et al. (2006) note, future changes in the surrounding landscape and climate may well decouple the long-standing link between material condition and the past practices that created it, forcing conservationists to make a choice between preserving the landscape's material composition or its past management practices.

Both approaches therefore make logical sense but have their inherent limitations, and what is not clear is the extent to which one or the other, or a hybrid thereof, actually influence the management

of the landscape. Better understanding of the functioning of such approaches, and the factors affecting their application, are required to inform conservation management, especially in light of potential climatic, land management and political economic changes. For example, for grasslands, climate change, through changes in temperatures, is likely to impact on hay cutting dates and on hay and grazing sward productivity, and through changes in rainfall patterns on flooding patterns and by extension on nutrient cycling. Similarly, changes in surrounding landscape such as adjacent land use and river management may again affect flooding patterns and nutrient levels, whilst local demographics and shifts in conservation funding may affect the availability of stakeholders to be involved in conservation management. Such changes would require modifications to grassland management in order to conserve desired features.

This paper contributes to knowledge and understanding on socio-ecological landscape management effectiveness (Stoll-Kleemann, 2010; Jones et al, 2012; Vokou et al, 2014)) by examining the practices of conservation actors, through the case of floodplain meadows in England. The work compares the responsive management model and what is termed here the 'traditional management' approach, asking two questions. Firstly, to what extent is there evidence of the predominance of either approach in the management of particular landscapes of conservation interest? Secondly, what are the implications and challenges of these management approaches for both the stakeholders adopting them and the landscapes being conserved?

2 Methodology

In order to address these questions, the factors and processes that determine management delivery on high conservation value grassland sites were explored. For a number of case study floodplain meadows in Lowland Central and Southern England (Table 1 and Figure 1), the stakeholder networks that delivered management on the meadows, the factors that informed decisions about meadow management and the associated decision making processes were identified, as well as the extent to which the outcomes from meadow assessment activity or generation of knowledge and understandings about management were influential under a model of either responsive or traditional management.

The key drivers that influence the floristic composition of such floodplain meadows are well known and researched, and include the hydrological regime, the mesotrophic soil nutrient conditions and nutrient flows associated with river silt delivered by flooding patterns, and the meadow management regime (Mountford et al 1993, 1996; McDonald, 2001; Gowing et al, 2002, 2005; Crichley et al, 2007). The broad lines of past long-standing meadow management regimes and the impact of particular management operations on the grassland sward and species composition are also well-known and researched (Crofts and Jefferson, 1999; McDonald, 2001; Gowing et al, 2002). The management regime broadly consists of a hay cut in late spring or early summer, followed by aftermath grazing in the autumn, usually with cattle.

Meadow management was investigated using mixed methods (Creswell, 2011). In order to identify the key meadow management activities, and to interrogate the range of factors and processes that influenced meadow management, a range of research methods were used including semi-structured interviews (Longhurst, 2010), participatory and non-participatory observation (Laurier, 2010) and archival research (Black, 2010). In this way, the generation of a variety of data types allowed triangulation between different sources of evidence regarding factors affecting management. Three meadows were studied in detail (Case Studies 1-3, Table 1: North Meadow, Brook Meadow and Long Mead) to generate rich data on these specific cases, with which to generate detailed understandings about the complex issues involved. In addition, a further nine meadows were studied to a lower level of detail in order to provide data against which to test the findings from the main case studies in order to improve the generalisability of any findings.

The case studies were selected to represent a degree of geographical spread across the region in which most meadows are located, as well as a range of conservation designation status, from high-profile internationally protected SAC sites to lower-profile non-statutory CWS sites (see Table 1 for definitions). This said it did not prove possible in this study to include meadow sites with no conservation stakeholder involvement at all, as the owners approached declined to participate, and so the situation regarding such meadow sites remains in question.

Table 1 – Case study meadows (see also Figure 1)

Case study number (Fig 1)	Meadow name	Location	GB OS Grid Reference	Area (ha)	Conservation designations
1	North Meadow	Cricklade, Wiltshire	SU094946	44.4	SAC, NNR, SSSI
2	Brook Meadow	Darley Green, Warwickshire	SP180743	1.73	SSSI, CWS
3	Long Mead	Eynsham, Oxfordshire	SP440086	10.5	CWS
4	Mottey Meadows	Wheaton Aston, Staffordshire	SJ 840134	44.6	SAC, NNR, SSSI
5	Portholme	Huntingdon, Cambridgeshire	TL 238708	104	SAC, SSSI
6	Oxford Meads (Pixey and Yarnton)	Wytham/ Cassington, Oxfordshire	SP480105	86.9	SAC, SSSI
7	Sherbourne Meadows	Norton Lindsey, Warwickshire	SP 242618	21.5	SSSI
8	Birches Barn	Polesworth, Warwickshire	SK 282021	10.7	SSSI
9	Welford Fields	Welford on Avon, Warwickshire	SP 140529	2.1	SSSI
10	Seaton Meadows	Harringworth/ Seaton, Rutland, Leicestershire	SP 915979	11.4	SSSI
11	Racecourse Meadow	Stratford upon Avon, Warwickshire	SP 185536	1.7	SSSI
12	Deans Green	Ullenhall, Warwickshire	SP132633	4.9	CWS

SAC = Special Area for Conservation; SSSI = Special Site of Scientific Interest; NNR= National Nature Reserve; CWS= County Wildlife Site[1]

[1] SAC is an international statutory nature conservation designation of the European Union, SSSI and NNR are statutory designations of the UK Government, and CWS is a non-statutory designation used in English local government for spatial planning purposes.

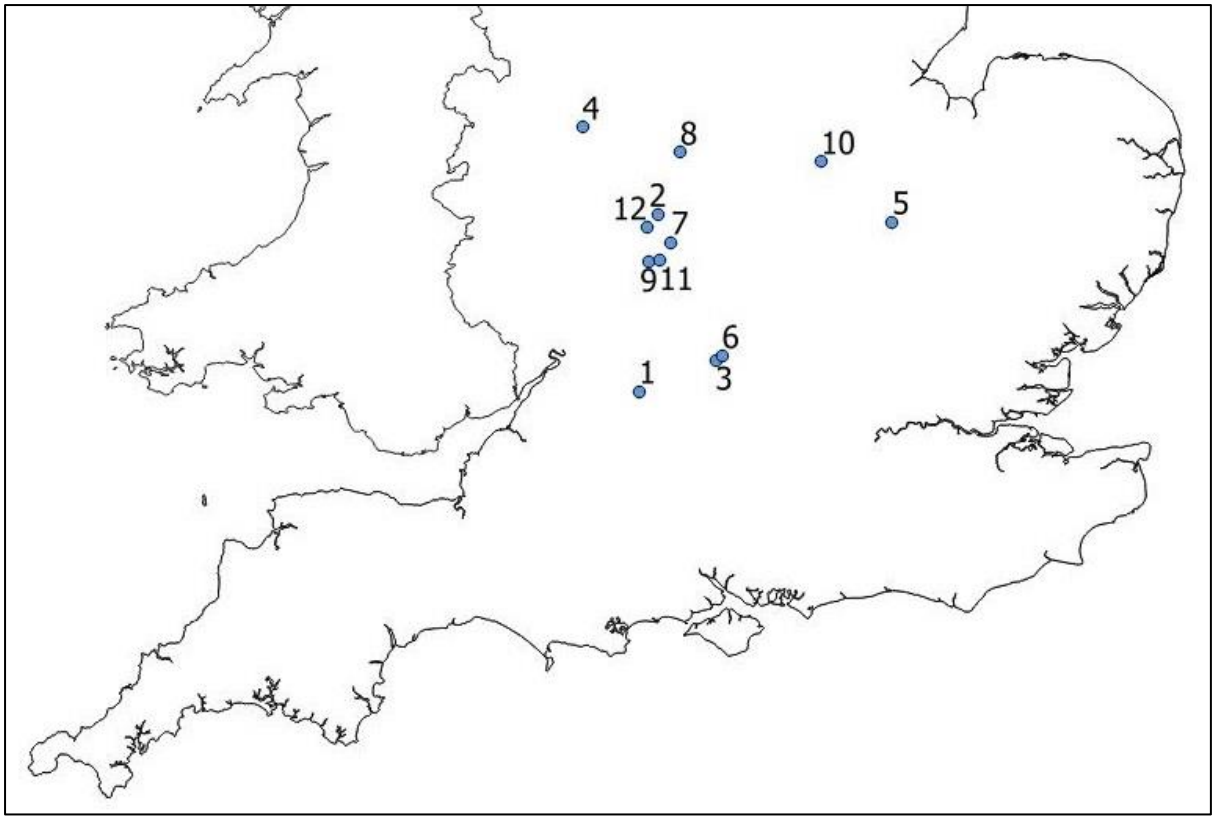

Figure 1 – Location of case study floodplain meadows (sites names given in Table 1). McGinlay, James, GB National Outlines [SHAPE geospatial data], Scale 1:250000, Tiles: GB, Updated: 8 June 2005, Ordnance Survey (GB), Using: EDINA Digimap Ordnance Survey Service, <http://digimap.edina.ac.uk>, Downloaded: November 2014.

The stakeholder networks identified were unique to each case study site but generally comprised three essential groupings: landowner, conservation organisation or conservation-interest party, and farmer/land manager or other agricultural-interest party. One entity might fall in to more than one grouping, but at least two such entities were identified at each site. For the purposes of this analysis, the stakeholders involved in managing the case study floodplain meadows have been divided into two broad groups: conservation-orientated stakeholders whose primary interest is nature conservation, and farmer-managers whose interest is primarily agricultural. In reality, these two broad groups represent a spectrum of views, perspectives and interests which overlap to some degree. The landowner could fall into either group. Generally, large sites tended to have more stakeholders involved, with for example several hay farmers and a separate grazier. However, most inter-stakeholder relationships generally consist of a primary one-to-one relationship between the conservation stakeholder or responsible landowner and each managing farmer.

The semi-structured interviews investigated in detail the role of each stakeholder in the meadow management network, their activities, timings and constraints on them, their decisions, if any, regarding management, and factors influencing or constraining their scope for action. Interactions with other stakeholders were also investigated, as well as formal structures, processes and rules (e.g. permission needed for hay cut), and the degree of adherence to these. These accounts of management activities were triangulated with reviews of formal documentation (e.g. agri-environment agreements), as well as site observations. Interviews were also used to capture

stakeholders' ideas and perspectives about meadow value and the meaningfulness of meadow conservation, as well as their opinions on the management regime and its appropriateness. To obtain evidence on the role of ideas about 'traditional' management, stakeholders were asked about what constituted such management, the knowledge they drew on, as well as how past management related to contemporary management. Ideas about past practices could then be compared with other sources of knowledge from literature, archives and other secondary data such as interviews recorded with elderly residents near North Meadow, Wiltshire (Snakeshead Revisited Project, conducted by the Manorial Court and supplied by Natural England).

In order to obtain evidence regarding a functioning model of responsive management, any activities - whether formal or informal - that were intended to assess and evaluate the condition or management of the meadows were investigated via the interviews, reviews of formal documentation such as management plans and monitoring protocols, formal archive records and informal notes of assessment activity, as well as participant observation of assessment activities. The latter included participation in botanical assessments to characterise the process and how findings were translated into conclusions and decisions about meadow condition and management.

In total 53 semi-structured interviews were conducted (March 2010 to December 2012) and 23 observational activities were undertaken (April 2010 to January 2013), as well as weekly to monthly visits to observe the progress of management on selected sites in summer 2011. Where reference is made to specific interviewees or where quotations are used, these have been anonymised.

3 Results

The key management activities delivered on the case-study meadows were cutting the meadow hay; the duration, intensity and type of grazing; as well as the application of fertilization (manuring), and rolling and harrowing. Factors seen to influence management undertaken on the meadows included: the results of monitoring and assessment activity including that intended to inform responsive management, ideas and narratives about past management practices including those that could be deployed to inform the traditional management approach, and practical constraints such as the weather (such as rain or flooding interrupting the hay cut) and legal controls on grazing animal movements. A further factor influencing observed management was the power relationship between the conservation stakeholders and farmers, which influenced the balance of weight given to the various factors in making decisions about management.

3.1 Monitoring and assessment methodologies

Almost all assessment activity noted on the case study meadows was undertaken by conservation stakeholders and consisted primarily of botanical grassland rapid assessment methodologies, especially that devised by Natural England[2]. This assessment was based on the presence or absence of readily-identifiable positive and negative indicator plant species or species groups, as well as a few indicators of grassland sward structure and ground conditions (Robertson and Jefferson, 2000). This assessment was deployed at a number of the case study sites by Natural England. In addition, at the five internationally important SAC meadows, the Floodplain Meadow Partnership (a research consortium) also undertook annual botanical fixed-point quadrat surveys and reported the results to Natural England.

Where assessments were undertaken by other conservation stakeholders such as local Wildlife Trusts (local nature conservation charities), these were again rapid condition assessments, identical to the Natural England assessments in underlying philosophy and structure, although the indicator species list varied slightly. Such assessments took place periodically at all sites except Long Mead, which has no legal statutory protection, although an informal assessment was made every 1-2 years related to the meadow's agri-environment scheme, based on a rapid walk-over assessment by a trained professional. Some stakeholders noted the limited impact of such assessment activity on management decision-making. For example, staff at one Wildlife Trust noted that their assessments were not yet influencing management, and no connection was identified between the results of assessment and management activities at their meadows. At Long Mead, little assessment activity took place and the meadow owner noted that practical constraints were dominant in determining management delivery.

As regards recording of agricultural parameters, a minority of farmers continued to record hay yields, for example at Oxford Meads, Mottey Meadow and at Long Mead. However, they rarely shared these data with conservation stakeholders, and at North Meadow most farmers reported that they had stopped recording hay yields as they saw no scope to influence management decisions. This was despite the fact that Natural England had recommenced the recording of hay yields. Most other conservation stakeholders did not retain records of hay yields, suggesting that

[2] government agency responsible for statutorily-designated nature sites in England, and administering government agri-environment schemes

this information was considered relatively unimportant. Indeed in interview, staff at one Wildlife Trust noted for that they did not record hay yields and were unsure of the utility of such data. Overall, few stakeholders recorded metrics of agricultural performance, and these data appeared to have no significant influence on management decisions or activities.

Regarding the recording of meadow management activities, the only systematic monitoring found was the recording of the hay cut dates and number of grazing animals at Oxford Meads by the managing company, and of grazing at North Meadow by the Natural England management. One hay farmer at Mottey Meadow recorded the dates of agricultural operations. Recording of management was not found at other sites by either conservation or farmer stakeholders, even though at some sites farmers were required to report this information to Natural England as a condition of their management contract. Data sharing between stakeholders appeared to be uncommon.

3.2 Ideas and narratives regarding past management practices and management decision-making

Regarding the hay cut, fertilisation, and rolling and harrowing, strong narratives about the appropriateness of these operations were held by conservation stakeholders. These influenced the decisions made regarding management decisions such that responsive management decision-making was constrained, as conservation stakeholders generally held power in the stakeholder network as a result of their responsibility for statutory protection of the meadow, or through administration of financial support for meadow management (agri-environment schemes). The exception was the grazing regime, where the difficulty of recruiting graziers appeared to weaken the conservation stakeholders' power such that decisions over grazing were more balanced between the priorities of the conservation stakeholder and the grazier.

3.2.1 Hay cut

On all meadows studied, the earliest permitted date of hay cutting was determined by the conservation-interest partner. The date from which the hay cut was permitted was most commonly after 15th July and was stipulated in a site management plan, agri-environment agreement, or contractual agreements between the conservation stakeholder, landowner, and managing farmer. Various sources including interviews, management plans and guidance documents attributed the above date to the aim of reconciling hay quality, which would in some seasons be maximised with an earlier hay cut, and the desire to protect ground-nesting birds and also to allow meadow plants to drop seed. In this regard, the North Meadow management plan noted that floral diversity took precedence over hay yield. Interviews with both farmers (such as one former farmer of Portholme meadow) and conservationists suggested that in the past hay cuts generally started as early as late May. This suggests significant divergence between common contemporary practice and past practices.

On all case-study meadows, interviews with farmer-managers revealed that they did not make any assessment of meadow condition before the meadow hay cut as they felt that the fixed start date limit was either late enough or too late and that by then the hay quality was beginning to decline. As a result all farmers said that they began to cut the meadow as soon as possible from this date, not only to achieve the best quality crop and avoid interruptions by rain, but also because they felt that the late start date limited the time they had available at a busy time of year to attend to their other work.

The only instance where monitoring and assessment appeared to influence management was at North Meadow. Here the hay cut date has been varied in recent years and set earlier following summer floods in 2007 and 2008 that reduced plant species diversity of the grassland sward, and that left the litter of hay uncollected, as noted in assessments. Consequently the hay cut dates were brought forward with the site management's permission to allow farmers time to cut the hay and accommodate wet weather.

3.2.2 Fertilization

Similarly, the role and appropriateness of nutrient additions to meadows in order to increase productivity appeared to be controversial and contested. Guidance (Crofts and Jefferson, 1999) states that floodplain meadows are fertilised by silt from seasonal flooding from watercourses and therefore further nutrient input is unnecessary unless declining hay yields can be demonstrated. Meadow-specific management plans and agreements with farmers thus restricted this practice by limiting nutrient inputs to well-rotted farmyard manure and limiting application rates. In reality, this practice was not observed at any case study meadows, nor was evidence found that manuring had occurred at any site in recent years. Rodwell et al. (2007) do however note that changes in the distribution and decline in livestock numbers in England has led to a decline in the availability of farmyard manure as an alternative to synthetic fertilisers.

Very little documentary evidence was found to confirm the extent to which the case-study meadows were fertilised historically, although at North Meadow farmers indicated that farmyard manure was applied to the site historically. In the Snakeshead Revisited Project interviews, elderly residents of the Cricklade area suggested that manuring was practiced on the meadow before the 1970s, a view corroborated by the Hayward (appointed to oversee meadow grazing).

Limited hay monitoring data from three sites (North Meadow[3], Mottey Meadow and Yorkshire Derwent Ings) indicate that hay yields may be declining at some meadow sites, and also demonstrate that yield monitoring needs to maintained over a long period (10-20 years) in order to confirm any trend (see Figures 2 and 3).

[3] Data obtained for the years 2009-2011 indicated average hay yields of 2.5–3 tonnes/hectare across the meadow compared with 3.5–4.5 tonnes/hectare a decade earlier (1999-2001).

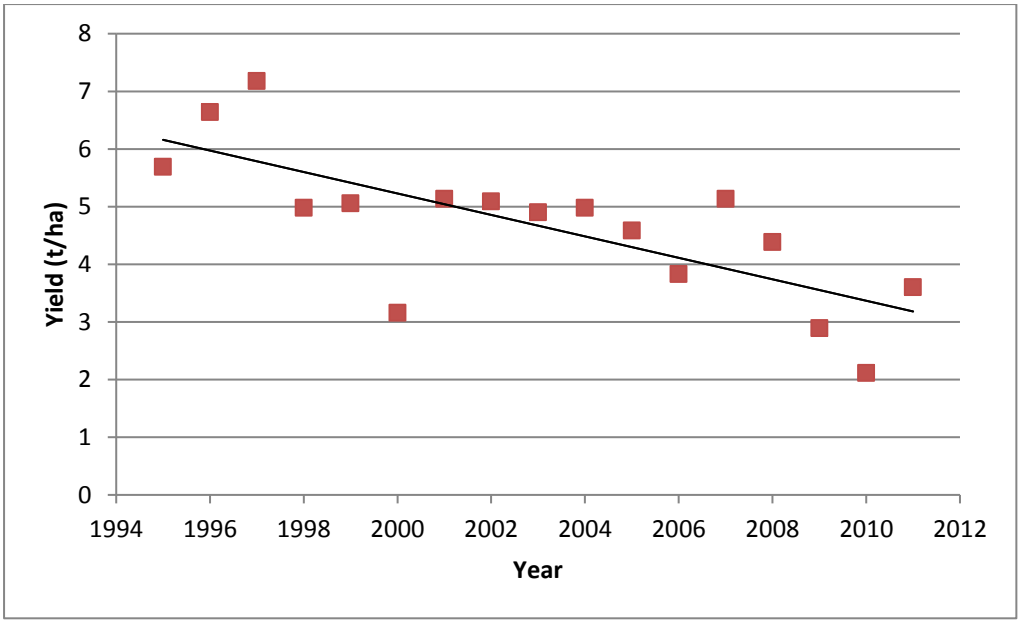

Figure 2 – Hay yields recorded for the two northern-most fields (compartments 2 and 4) of Mottey Meadow NNR, Staffordshire (R^2 = 0.5413, P < 0.001). It should be noted that the statistics have been calculated based on only 17 data points.

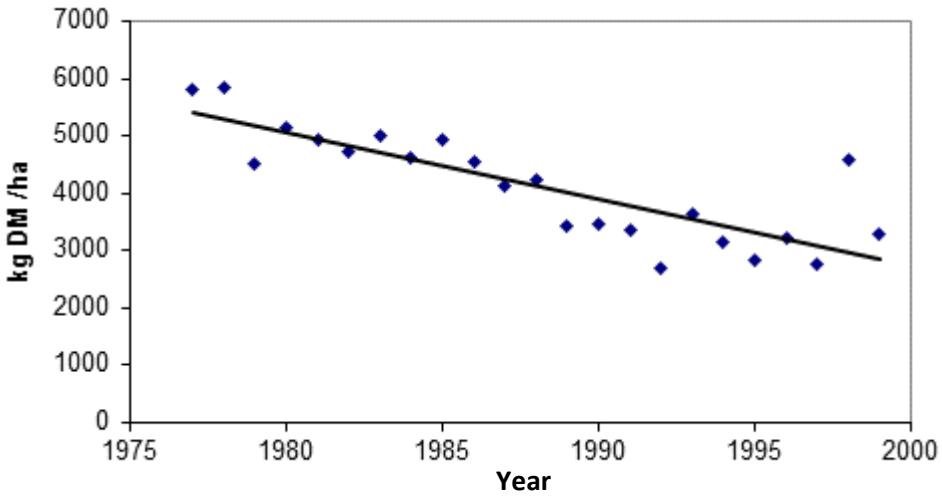

Figure 3 – Mean hay yield from East Cottingwith flood meadows (Derwent Ings, Yorkshire) (R^2 = 0.736, P<0.001) (Graph taken from: Gowing *et al*, 2002).

3.2.3 Grazing

In contrast to the above management operations, conservation stakeholders appeared to take a more 'hands-off' approach in determining the precise parameters of meadow grazing regimes. Formal agreements governing grazing of the meadows generally stipulated the type of animal (usually cattle), limits to the grazing period and the maximum stocking density. In reality, many of the owners and managers of the case study meadows had difficulty engaging graziers to graze the meadows. For example, one landowner noted that her meadow was typically under-grazed owing to a shortage of and competition for grazing cattle locally, whilst the Hayward for North Meadow reported that cattle herds grazing the meadow are smaller than in the past, with no cattle grazing at

all between 2001-2009. At North Meadow and Brook Meadow, in some years the grazier removed the cattle after two months as they were required to be retested for bovine tuberculosis and it was neither convenient nor cost effective to return the cattle to the site.

4 Discussion

The above results suggest limited evidence for a consistently functioning model of either responsive or traditional management, which begs the question of why neither of these two approaches appears to function consistently.

Regarding meadow value, what Forsyth (2003) calls a 'dominant hegemonic discourse' appeared to impose a natural-scientific view of which aspects of meadow value are worth conserving and which are not priorities. From this perspective, botanical composition is the primary value and other forms of value, including agricultural value, are relegated, as evidenced for example, by the North Meadow management plan that states that floristic diversity is more important than hay yield, and by the strong focus of monitoring and assessment on botanical composition. It is widely acknowledged that high nature value areas based on socio-ecological landscapes are socially and culturally derived and will evolve over time (Ratcliffe, 1977), and it must be recognised that the agricultural outputs were historically the primary driver that created the such landscapes. Attempts therefore to detach the two forms of value and dismiss one as irrelevant are questionable and may be unrealistic as the two are inextricably linked, and neglect of the maintenance of one aspect of meadow character may have implications for others.

An element of tension nevertheless appears to exist between the vision of meadows as landscapes co-produced by biophysical and social processes, as widely acknowledge by many conservationists (e.g. Losvik, 2003, Fischer et al, 2012), and an alternative tendency to frame such socio-ecological landscapes as 'natural'. The latter may result from conservationists' anxiety to conserve nature in the face of social pressures, as well as by the popularity in some areas of the conservation movement of the concept of 'rewilding' (Sutherland et al, 2010; Monbiot, 2013), perhaps encouraging conservationists towards a 'minimum intervention' approach to management. This approach may be evidenced in the reduction or cessation of manuring, and of rolling and harrowing in ways that do not appear to represent actual past management practices, or in the compromising of past practices to contemporary 'natural' concerns, such as the delayed hay cut to accommodate ground-nesting birds. However, as noted by many environmental social scientists (Cronon, 1995; Castree, 2001; Demeritt, 2001; Proctor, 2001, Adams, 2004, Castree, 2005; Ginn, 2009), including a strong consensus of nature conservation researchers, any attempt to frame such socio-ecological spaces as 'natural' and 'non-social' is problematic.

Assessment activity focused heavily of botanical aspects of value ('natural' value - conducted by conservation stakeholders) and to be patchy, inconsistent or absent for other aspects of value such as agricultural value ('social/cultural' value: hay quality of quantity, grazing sward quality and quantity). Also, crucially, recording of management activities is key to a functioning model of responsive management and its absence calls into question scope for following this model. Monitoring activity therefore was dominated by conservation stakeholders recording data on selective aspects of the meadow and with particular views of what kinds of data are valid.

A range of issues therefore limit the responsive model. Firstly, management is not recorded, perhaps in part because it is not necessary under the traditional management approach. Secondly, the partial view of meadow value captured by the monitoring activity limits the ability to respond in a way that will safeguard the interconnected aspects of meadow value. Thirdly, making management decisions based on standard prescriptions backed by theoretical narratives on meadow value and management precludes the possibility of making management decisions responsively based on evidence from assessments of actual site condition.

Conversely, the traditional management model, which could fill gaps caused by uncertainties in the responsive model (Crofts and Jefferson, 1999, Freese et al, 2014), cannot be enacted effectively because evidence for past practices is lacking and because the evidence that does exist does not appear to impact on management decisions, perhaps because its qualitative nature means it is regarded as anecdotal. Yet where the traditional management approach is difficult to implement due to uncertainties or disputes over the nature of historical practices, the gaps cannot be filled by a responsive approach either for the reasons given above.

Overall, neither the responsive model nor the traditional management approach functioned fully and consistently in practice. As noted, this results from the imposition by conservation actors of narratives about meadow value, management and about what constitutes valid data, which leads to contradictory interpretation of evidence, thereby undermining both models. In reality however, conservation actors' power in this regard varied with a site's level of statutory legal protection, and their ability to recruit and retain farming partners to deliver management. Furthermore, a number of other practical constraints influenced the management delivered on meadows that undermined the ability of managing actors to act responsively (e.g. sourcing natural fertilisers, wet weather, limits on grazing through animal welfare and hygiene). All these practical factors may restrict stakeholders' scope for action irrespective of what practices may be preferred under a model of either responsive or traditional management.

Ultimately, both the responsive and traditional management approaches are models rather than absolutes that must be followed rigidly. They are successful if they deliver meadows as desired by the diverse stakeholders with an interest in their conservation. As noted, they may be complementary and able to compensate for each other's weaknesses. The Traditional management model is logical as noted by the many researchers who emphasise the cultural origins of European socio-ecological landscapes (Bignal and McCracken, 1996; Bezak and Halada, 2010; Birge and Herzon, 2014). However, as Harris et al (2006) note, changes in climate and the surrounding landscape may well shift the relationship between management practices and their impact on landscapes, so that whilst others emphasise the threat of abandonment of such practices and associated 'traditional ecological knowledge' (Prince et al, 2012; Babai and Molnar, 2014, Joyce, 2014), a functioning model of responsive management will also be required to compensate for the shift in the management-materiality relationship beyond the long-term historical situation.

To operationalise the responsive management model more fully, conservation managers should consider the past social and ecological drivers that created the landscapes they wish to conserve, such as the use of extensive grasslands in Europe for agriculture and pastoralism. They should bear in mind that this is necessarily implicated in any aspects of landscape value, and ensure that indicators of it too are captured in any assessment and evaluation of the site's condition. Given the

lack of funds for intensive quantitative field surveys at most protected areas, qualitative data from other sources of knowledge should be at least considered or tested using scientific or other research methods. Similarly, lay evidence for past historical practices should at least be examined before being dismissed. Conservation managers should question whether they reject such ideas on the basis of alternative evidence or on the basis of engrained beliefs that may arguably be more ideological than empirical.

Ultimately, the perceived value of meadows has always changed, as social, economic and cultural processes evolved. As the agricultural production of meadows became uncompetitive relative to intensive farming, it is nature conservationists who secured the conservation of many remaining meadows. Agricultural production on meadows can still provide some economic support to their management, as evidenced by the willingness of some farmers to pay to take the hay or graze, and thus should not be dismissed entirely. The shift of focus away from meadows' agricultural value towards their botanical value reflects a shift of interests of the diverse stakeholder networks involved in meadow management, but should be seen as a balance of complementary ecosystem services rather than a rigid dichotomy. If contemporary conservation produces meadows that are more botanically diverse, but less productive than in the past, this may be acceptable. However, it is important that conservation practitioners are clear of the implications and consequences of their management decisions, and that any changes to meadows resulting from them are acceptable to the various stakeholders with an interest in meadow conservation.

5 Conclusions

In conclusion, results suggested limited evidence for a consistently functioning model of either responsive or traditional management in the conservation of socio-ecological landscapes. The significance of the inconsistent functioning of these models for nature conservation practitioners is that they may not be conserving such landscapes as they were in the past.

The framing of socio-ecological landscapes as 'natural' rather than 'social' (Castree, 2005), in combination with dominant narratives regarding their value and past management (Forsyth, 2003) strongly influences the approach adopted to landscape management. This includes presumption towards a 'minimum intervention' approach to management as well as monitoring and assessment activity that provides a partial view of landscape value and status, and that is of limited value for the purposes of responsive landscape management (Sheil, 2001; Danielsen, 2005; Legg and Nagy, 2006). In combination with firmly held views regarding past management practices (Dinnie, 2015) such framings also influence interpretation of evidence regarding past management under the traditional management approach.

On the one hand monitoring and assessment undertaken to inform the conservation of socio-ecological landscapes must be holistic enough to capture not only nature conservation-related biological value, but also measures of other forms of value relating to social and cultural processes that co-produced the landscape, such as agricultural productivity, as well as metrics of landscape management in order to operationalise the responsive management approach and tighten the adaptive cycle (Uychiaoco, 2005; Carruthers et al, 2013). On the other hand, a broader range of evidence of past management should be considered, along with recognition that past practices will have been site context-specific and have varied in space and time. In particular, qualitative evidence should not be automatically dismissed as 'anecdotal', and socio-ecological landscapes should be acknowledged as both natural and social, to avoid presumption against long-standing management practices on ideological grounds.

Finally, it needs to be recognised that changes in land management, climate, political economy, local demography, and cultural attitudes will to some degree decouple the long-standing relationship between management practices and landscape nature, function and use. Provided a consensus can be reached among stakeholders on what aspects of socio-ecological landscapes should be conserved and which may change, a management model combining the advantages of the responsive model and the traditional management approach may allow us compensate for their respective disadvantages, and permit the conservation of complex dynamic landscapes that in reality have always changed according to social and cultural desires and may continue to do so. Debate needs to focus on the continuing value of such landscapes in a way that recognises them as not just natural but also social/cultural spaces, and accepts that these forms of value are interlinked. Attempting to totally separate the two forms of value may mean we conserve them neither as they were nor as we want them to be, may destabilise their management models, and ultimately may even make their management economically unsustainable.

6 Acknowledgements

For their assistance and co-operation during the undertaking of this research, thanks are due to: Natural England, Warwickshire Wildlife Trust, Berkshire, Buckinghamshire & Oxfordshire Wildlife Trust and Thames Valley Environmental Records Centre, as well as to the many anonymous interviewees who kindly gave their time. Finally, thanks are due to the anonymous reviewers for their helpful comments leading to the significant improvement of the manuscript. Any remaining shortcomings or errors are our responsibility alone. The work was undertaken as part of a PhD funded by the Open University(McGinlay, 2013).

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