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Biodiversity of plants and animals in grassland systems : approaches to conservation and restoration in England

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Key points : In England the very best examples of wildlife habitats are National Nature Reserves which are publicly owned and managed ; these cover only 0.3% of the land area . Much of the biodiversity resource is therefore embodied in land managed and usually owned by private farmers . The best of this is designated as Sites of Special Scientific Interest (SSSI) , protected by law . But most plants , invertebrates , birds and mammals are found on land with little or no legal protection . This wildlife declined greatly from the 1960s and in the 1980s voluntary agri-environment schemes were introduced . These offer payments , for 5 or 10 year periods , in return for adherence to prescriptions designed to maintain and enhance biodiversity whilst allowing farming to continue . They are popular and on land in agreement the decline in biodiversity has largely been halted . The challenge now is to broaden their scope , focus them more effectively on restoration and use them together with other mechanisms such as premium markets to secure their benefits in the long-term .

Key words : grassland , biodiversity , agri-environment , conservation

Land use , ownership and designations England is densely populated with an average of 387 people per km² . Only 19% live in rural areas (ONS , 2007) . Figure 1 shows the proportion of land used for different purposes . Over 70 per cent of the land is in agricultural use ; grassland and rough grazing (over 4,700,000ha) is the single largest usage (Defra , 2007a) . The great majority of land is privately owned with relatively little owned by the government . (Cahill , 2002) . The average size of farm is 112.7ha (excluding those holdings classed as spare/part-time) ; well above the EU average . The majority of agricultural land is owner-occupied (66%) with the remainder tenanted , often from large landowners or charities (Defra , 2007b) .

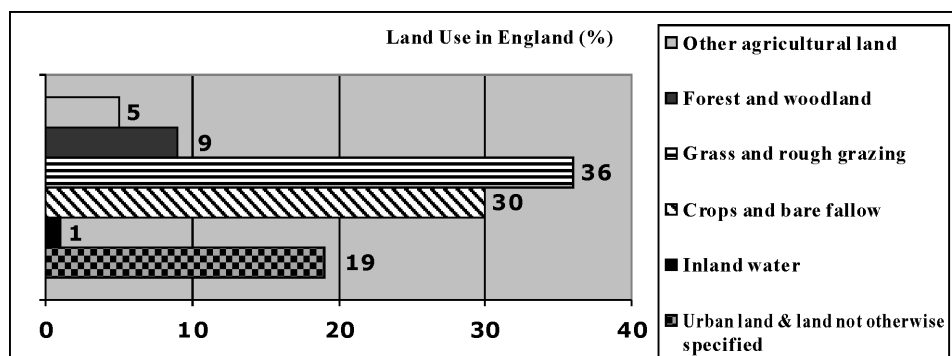


Figure 1 Land use in England .

The 9 National Parks , which are predominantly grassland and moorland , cover 8% of England and the 36 Areas of Outstanding Natural Beauty (AONBs) cover a further 15% . These are the most beautiful landscapes in the country and although predominantly in private ownership their designations mean that housing , industry and other building development is more controlled than elsewhere . Sites of Special Scientific Interest (SSSIs) represent the country's very best wildlife and geological sites . There are over 4,000 SSSIs in England , covering around 7% of the country's land area , and some of the best of these are designated National Nature Reserves . Most of these , some 32431ha of terrestrial habitat , are owned and managed by Natural England .

European policy context The key policy driver is the EU Common Agricultural Policy (CAP) . From the mid 1960s financial assistance was provided for the restructuring of farming . By the mid 1980s , there were almost permanent surpluses of the major commodities . Storage , disposal or subsidised export of these had a high cost , distorted some world markets , and became unpopular . In 1992 the McSharry reforms were agreed which involved reducing support prices and paying farmers direct aids . Several rural development measures were introduced , notably to encourage environmentally sound farming (Winter , 2000) .

This shift of emphasis in the CAP entered a new phase with agreement in 1999 on the so-called 'Agenda 2000 reforms' (European Commission , 1999) . These reinforced the move to make farmers more reliant on the market and strengthened environmental incentives . As a result EU spending on agriculture is now made through two different components (pillars) of the CAP .

Table 1 *Pillars 1 and 2 of the Common Agricultural Policy .*

Pillar 1-Market and Income Support	These measures cover direct payments to farmers and continuing market-related subsidies such as buying of products into public storage , surplus disposal schemes and export subsidies .
Pillar 2-Rural Development	Measures aimed at environmental services , assistance to difficult farming areas , promoting food quality , higher standards and animal welfare . They are jointly funded by the EU and by Member States and help farmers to diversify , improve marketing and otherwise restructure their businesses .

Further fundamental reforms in 2004 and 2005 involve a major strengthening of pillar 2-mainly through modulation which is effectively a progressive transfer of resources from pillar 1 (European Commission , 2003) . Pillar 1 payments were also decoupled from production and consolidated as the Single Payment Scheme (SPS) . Importantly this payment is conditional on meeting a series of environmental Cross Compliance requirements . Despite this Pillar 1 represents 79% of the CAP budget for 2007-13 (European Parliament , Council , Commission 2006) . In England Single Farm Payments under Pillar 1 average £245/ha/yr .

Pillar 2 is implemented through the Rural Development Programme for England (RDPE) (Defra , 2007) . This sets out national spending priorities against the menu of measures available in the EU Rural Development Regulation (European Council , 2005) . England is unusual in the EU because 80% of the funding is allocated to activities associated with improving the environment and countryside by supporting land management . This compares with 30% in the Netherlands , 34% in Poland , 54% in France and 74% in Sweden .

Scope to fund agri-environment schemes (aes) has been a component of EU-funded rural development programmes since the 1980s . For example Article 39 provides for annual payments to farmers who voluntarily make agri-environmental commitments , provided they only cover those activities that go beyond mandatory standards in EU and national legislation .

The combination in England of high population , intensive farming , and predominantly private land ownership coupled with funding from the rural development programme means that in order to conserve and enhance biodiversity we have developed an approach largely based on incentives supported by advice and underpinned by regulation .

Legislation and cross-compliance : the regulatory levels of conservation There is a considerable body of British and European law to protect biodiversity . Some SSSIs also have international designations (eg Special Areas of Conservation ; Ramsar sites for wetlands) . Many other sites have lesser designations eg County Wildlife Sites , Site of Interest for Nature Conservation . These , and all other natural and semi-natural habitats , have some legal protection . In 2005 this was consolidated with non-mandatory codes of practice to form the Cross Compliance requirements with the underlying principle that for farmers to be eligible to receive payments under the SPS , the land they manage should be in Good Agricultural and Environmental Condition (GAEC) . Table 2 shows the main requirements relevant to grassland , moorland , heathland and other grazed habitats .

Table 2 *Main regulatory protection for grassland and related habitats in England .*

Habitat	Area (000ha)	Cross compliance requirement	Legally enforceable ? (wholly or partly)
All agricultural land (including common land) .	9719	GAEC 10 . Burning of grass and heather allowed only in winter and limited in extent .	Yes
		GAEC 11 and SMR5 . Spread of specified weeds (native and alien) must be controlled .	Yes
		GAEC 13 . When soil is waterlogged do not use machinery .	No
All grassland not in crop rotation in last 5 years .	3373	Permanent pasture provision . Area in England must not fall below area in 2003 .	No
All uncultivated land and semi-natural areas .	>984	GAEC 5 . Environmental Impact Assessment ; must seek permission for agricultural intensification .	Yes
All natural and semi-natural vegetation .	984	GAEC 9 . Do not overgraze or offer livestock supplementary feed in a way which damages vegetation .	No
Sites of Special Scientific Interest (terrestrial) .	769	GAEC 6 . Do not destroy or damage interest features . Notify Natural England of any proposed operations likely to damage features .	Yes
European protected plant species .	—	SMR 5 . Do not pick , collect , cut , uproot or destroy .	Yes

GAEC= Good Agricultural and Environmental Condition standards .
SMR= Statutory Management Requirements .

There is also a large body of legislation to control pollution, including the control of gaseous emissions such as sulphur & ammonia which are damaging to terrestrial habitats.

Incentives : voluntary agri-environment schemes to encourage and reward conservation and restoration

Classic schemes 1987-2005 Agri-environment schemes began in 1987 as the Environmentally Sensitive Areas (ESA) scheme, available in defined areas covering 10% of England. In most ESAs there were several tiers with different entry criteria and payments. Any farmer willing to meet the prescriptions of one or more tiers could have a 10-year agreement and uptake was high-64% of the eligible area was under agreement (Defra, 2006). In 1991 the Countryside Stewardship Scheme (CSS) was introduced. Farmers anywhere in England were eligible, provided their land had defined features, but they had to apply in competition for a finite fund of money. The scheme was popular and invariably oversubscribed. ESAs and CSS (now known as Classic Schemes) were multi-objective; as well as biodiversity they covered the protection of historic features, conservation and enhancement of landscape character, and provision of access for the public. They were relatively inflexible and many of the options within them, particularly in ESAs, had modest targets e.g. to prevent grassland in sensitive landscape locations from being ploughed or having fertiliser applied, for which the annual payment might be between £30 and £200/ha. And they encouraged reversion of arable land to grassland to benefit landscape and to support isolated remaining semi-natural grassland sites; typical annual payment £250-300/ha.

Eligibility for higher ESA tiers, and for CSS, developed over time. Crucially for botanical restoration no assessment of soil suitability was routinely made. Prescriptions were fairly rigid, no restoration plan was required and no targets were set at individual agreement level. From the mid-late 1990s there was a gradual increase in flexibility of the schemes; for example in some options the rigid limits on stocking rates were replaced by targets for sward structure. And entry criteria were raised. In particular we started assessing soil pH and nutrient status and giving priority to sites judged to have high potential (Stevenson, Peel and Christian, 2007) but this was only routinely applied from 2005 when a new scheme was launched.

Monitoring shows that to a large extent ESAs and CSS have succeeded in maintaining grassland sites of high existing value (e.g. Hewins et al., 2008; Manchester et al., 2008a). Increases in species-richness have been detected in some improved and semi-improved grasslands on chalk and limestone (Hewins et al., 2008), and in hay meadows (Kirkham, Fowbert and Parkin, 2004; Critchley et al., 2004). This enhancement has, however, been relatively slow and inconsistent. Monitoring in some ESAs (e.g. upland fringe grasslands, Manchester et al., 2008b) has shown little if any diversification in previously improved swards. Grassland in ESAs launched in 1987 have now been under extensive management for 20 years and the expectation at their launch was that restoration of species-diversity would occur much more rapidly than it has.

In 2002 a major review of AE scheme delivery began. The strengths and weaknesses of the schemes are shown in Table 3. As a result of the review ESAs and CSS were closed to new entrants in 2005 and a new scheme was launched.

Table 3 *Strengths and weaknesses of Classic Agri-Environment Schemes (ESA and CSS) in England.*

Strengths	Weaknesses
Introduced the concept that society was prepared to pay for management of the environment.	Entry denied to most farmers; either not in right area or land not having specified features.
Popular; high uptake by eligible farmers.	Objectives and priorities within agreements often not sufficiently clear. Baseline condition of features not recorded.
Good relationship between adviser and farmer.	Focus on prescriptions rather than outcomes.
Multi-objective schemes; potential for synergy.	Rather inflexible.
ESAs enabled entry to a simple tier, building confidence and trust, then upgrading.	Pro-active restoration not encouraged.
CSS competitive; could generate better-focused agreements.	CSS did not reward features that were already well-managed. Required to buy change.

Environmental Stewardship, 2005 onwards The new scheme builds on the strengths and seeks to address the weaknesses of the Classic Schemes. It has two tiers: *Entry Level Stewardship (ELS)* is open to all and is currently taken up by over 50% of farmers. It has a menu of over 60 options; 3 are summarised in Table 4. The most popular are those requiring good management of field boundaries; hedges, ditches and walls. The most popular in-field options are for the management of grassland using low or very low inputs. Farmers are sent a map of their farm and the boundaries of all parcels of land within it. The map shows any SSSIs, historic monuments and other recorded features; the farmer marks other features, such as mature trees, on the map. He then chooses options from the menu and marks which parcels he will apply them to. Each option is worth points; he must achieve an average of 30 points per hectare over the total area of the farm and is then automatically given a five-year agreement and an annual payment of £30/ha.

Table 4 Examples of popular options in Entry Level Stewardship .

Code	Option	Main prescriptions	Units	Points
EK2	Permanent grassland with low inputs .	Fertiliser limited to 50kg/ha of N ; no harrowing , rolling or cutting in April or May ; weed control only by spot-treatment .	ha	85
EK3	Permanent grassland with very low inputs .	No fertiliser ; no harrowing , rolling or cutting in April , May or June ; weed control only by spot-treatment ; no supplementary feed .	ha	150
EB1	Hedge management (both sides) .	Maintain height > 1.5m ; no cultivation , fertiliser or manure within 2m ; do not cut > once every 2 years , and not March-July .	100m	22

Higher Level Stewardship (HLS) is aimed at land with high-value environmental features or high potential to restore them . It has over 100 options and a wide range of capital payments . It is competitive and eligibility is based on sward , physical and soil properties . Prescriptions can be tailored to the site . Importantly applications must contain a detailed audit of environmental features and each option has Indicators of Success (IoS) so that progress can be judged . Whilst these are not legally binding they can be used to trigger adjustment at the 5-year breakpoint and/or the decision to renew the agreement after 10 years .

Table 5 Examples of popular options in Higher Level Stewardship .

Code	Option	Typical main prescriptions	Typical Indicators of Success	£/ha
HK6 HK7	Maintain or restore species-rich , semi-natural grassland .	No fertiliser ; no harrowing , rolling or cutting April , May , June ; weed control only spot-treatment ; no supplementary feed .	Soil P index 0 or 1 ; soil pH between 5.5 and 6.5 ; increase number and/or frequency of high value plant species .	200
HK9 HK10	Maintain or restore wet grassland for breeding waders .	Do not allow birds to be disturbed , and do not stock at > 0.75 LU/ha , from March to June .	Target bird species present between March-June ; 5-25% of surface has standing water March-May ; 5% to 60% cover of grass tussocks .	335
HR1	Supplement for cattle grazing .	Cattle will comprise at least 70% of the Livestock Unit Grazing Days .	—	35
HR2	Supplement for native breeds at risk .	Pedigree livestock from the approved list of breeds will comprise at least 70% of the Livestock Unit Grazing Days .	Number of pedigree-registered livestock must be maintained or increased .	70

Uptake of HLS is not intended to be high . Three years after launch there are currently just over 2000 agreements with a payable area of 180 000ha . This will rise gradually until 2015 as Classic Scheme agreements come to an end .

Evaluation of current regulation and agri-environment schemes Some aspects of the regulatory controls shown in Table 2 have worked reasonably well ; protection of SSSIs (GAEC6) has been generally effective and overgrazing of heather moorland (GAEC9) is now a much lesser problem due to effective cross compliance inspections , greatly helped by decoupling of livestock subsidies . By contrast the EIA regulations (GAEC5) have been largely ineffective due to weak interpretation and lack of clarity .

Agri-environment schemes have formed the core of environmental land management policy since the 1980s and are popular with farmers . The schemes are voluntary and allow continued use of the land . In deciding whether to commit to an agreement a farmer will consider the impact of the prescriptions and Indicators of Success and balance any restrictions against the payment offered . Where the objective is habitat maintenance there may be relatively little change to management . But in restoration options substantial changes may be required such as from sheep to cattle , and a commitment must be made to pro-active restoration such as introduction of seeds or green hay .

This approach has a number of key strengths :

- Regulation can provide basic protection for the most valuable sites .
- Entry Level Stewardship (ELS) shows that high uptake can be achieved for simple voluntary schemes , at relatively low administrative cost , providing some benefits over a large area . This is particularly valuable for most birds and some invertebrate species , making populations more able to adapt to climate change .
- Higher Level Stewardship (HLS) demonstrates how a very flexible scheme can be developed , in close consultation with farmers and other stakeholders , with a strong focus on outcomes and targeted at high-value sites .

but also has weaknesses :

- Basing annual payments on income forgone is inflexible, vulnerable to fluctuations in commodity prices and doesn't reflect the true public-good value of the ecosystem services that are provided. Payments are made for a prescribed management activity with no guarantee that this will achieve the desired objective.
- At the end of the agreement term (typically 5 or 10 years) there is a risk that the environmental benefits are lost if the agreement is not renewed.
- In ELS the hands-off administration and free choice of options does not easily allow targeting or a balance of measures.
- HLS like many incentive-based aes, has relatively high administrative transaction costs.

Future prospects

There is further scope to improve incentive-based agri-environment schemes :

-In ELS the choice of options may be limited by a requirement to choose some from a priority list. Additional advisory support is also likely (Defra, 2008).

-Differentiated payments (eg by region and/or farm type, size) that more accurately reflect compliance costs at farm level and minimise potential over/under compensation (Offerman, Nieberg and Hecht, 2008)

-In the longer term tendering/auction based approaches might be more cost-effective and have been used in some countries, although evidence is mixed (Latacz-Lohmann and Schilizzi, 2007). These approaches are still constrained by market values and do not effectively reflect the public-good value of the ecosystem services provided.

-Additional incentive mechanisms to secure co-ordinated landscape scale interventions, for example use of the agglomeration bonus (Parkhurst *et al*, 2002).

-A focus on payment by results rather than management prescription, eg a pilot project in Germany where farmers receive payments for maintaining identified target species in grassland (Ruffer, 2004).

-Similarly the debate about the multifunctional role of agriculture (OECD, 2001; Van Huylenbroeck and Durand, 2003) has highlighted its varying role in delivering non-trade concerns. Recently there has been increased interest in the ecosystem services concept as a framework for valuing non-trade environmental goods and services in decision-making (Defra, 2007a and b). Logically this could also be used to inform incentive scheme payments based on the value of ecosystem services provided, rather than the management prescription delivered.

There is scope to develop alternative funding sources for aes activity, for example :

-The continuing growth of product brands based on environmental/production system characteristics (eg organic) at premium price provides a valuable opportunity to reconnect consumers and producers. Regional/local/organic products currently represent about 10% of the market (Cabinet Office, 2008) and have the potential to generate additional income to support production systems that have environmental benefits.

-There are examples of national and local/voluntary taxation/tax allowances being used to fund/subsidise aes activity and there may be scope for further development in this area.

More fundamental approaches may also merit consideration. These could include :

-Securing long-term protection through conservation easements/covenants. These are not currently supported in English law but are widely used elsewhere in the world, for example Victoria, Australia. It is unclear how attractive this would be without incentive payments to support ongoing management.

-Public ownership. The prime European example is the Dutch National Ecological Network (NEN) involving the creation of a connected area of 738,500ha of nature reserves combining land purchase with agri-environment incentive schemes. Crucially it is set within a zoned approach to land use planning which is quite different from that in England and is heavily dependent on extensive political and public support (Hodge and Reader, 2007). Public land purchase is a strong guarantee of sustainable management and continuity but is extremely expensive.

-Tradeable permits are already used internationally to reduce carbon emissions and improve air quality and in a recent green paper the EC expressed an interest in using them for wildlife conservation. Each region could set a target for area of land for wildlife conservation and rely on the market to find the most cost-effective way of achieving it. A developer wanting to destroy habitat would purchase a permit from someone who has created valuable habitat elsewhere.

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