FARM MANAGEMENT IMPLICATIONS OF PROVIDING WET HABITATS TO IMPROVE BIODIVERSITY

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Abstract

Wet habitats are considered a potentially important component of the farmed landscape for biodiversity, including provision of a range of resources for declining farmland bird species. The Wetting Up Farmland for Birds and other Biodiversity (WUFFB) project in England is examining a number of small constructed wet features based upon their practicality, cost and potential to provide some of the resources required by farmland birds. Initial results from the project suggest that there may be significant costs associated with the establishment of such features, however, their impact on the farming system is minimal. In terms of environmental benefit, the short term nature of the project does not provide concrete results, although the features are successful in increasing the quantity of the wet habitat resource. Given time, it is also likely that an increase in farmland bird food resources and farmland birds would be evident.

Keywords: Wet habitats, Wetting Up Farmland for Birds and other Biodiversity(WUFFB),

Introduction

The decline of farmland birds in the UK and elsewhere in Europe is well documented (Donald et al., 2001; Krebs et al., 1999; Newton, 2004; Shrubb, 2003; Vickery et al., 2004a,b). In the UK, this has led to policy interventions and associated targets to reverse these trends, including agri-environment schemes and farm management practices which can provide the majority of nesting and feeding resources required by farmland birds (Vickery et al., 2004a).

One key omission in the current suite of options is the provision of wet habitats (Bradbury and Kirby, 2006, p531), as both permanent and temporary wet habitats have reduced in quantity and quality in UK lowland farming through neglect, infilling, eutrophication and pollution. Further, increased and improved under field drainage limits the time that soils remain wet, and reduces the period of outflow to ditches, resulting in fewer that remain wet year round.

Set against this is the increasing evidence that many farmland bird species make use of wet habitats on farmland, and that these habitats are a potentially important component of the farmed landscape for biodiversity and wider environmental services. Important resources include permanent water to provide water-dependent/wetland invertebrates as a source of food for wildlife higher up the food chain (Anderson et al., 2002; Davies, 1977; Nelson et al., 2003; Wilson et al., 1999), non-cropped vegetation adjacent to bare or sparsely vegetated ground in the draw-down zone providing a source of invertebrates next to a location where access to these food sources is relatively easy (Anderson et al., 2002; Bradbury and Bradter, 2004; Devereux et al., 2004; Perkins et al., 2002; Wilson et al., 2005), damp soil which provides a combination of soil invertebrates near to the soil surface and ease of soil penetrability for species that probe the soil (Devereux et al., 2004; Gerard, 1967; Green, 1988; Green et al., 2000; Kirby and Tyler, 1999; Sheldon et al., 2002), and rank emergent vegetation for nesting (Brickle and Peach, 2004).

The provision of resources for farmland birds and other biodiversity by wet habitats is therefore an emerging theme in policy and research.

The Wetting Up Farmland for Birds and other Biodiversity (WUFFB) project (2004-2007) examined a number of small constructed wet features: bunded-ditches, paired detention ponds, surface scrapes and waterlogged areas, based upon their practicality, cost and potential to provide some of the resources required by farmland birds. The aim was to demonstrate the most cost-effective and agronomically acceptable means of providing such resources in both arable and pastoral landscapes. The experimental work tested responses to delivery of these resources in replicated experimental trials.

This paper outlines the practicality of the proposed measures, the costs of establishment and ongoing maintenance costs, and, for arable systems, the potential detrimental impact on yields and therefore farm income. These are then set against the resultant benefits for farmland bird food resources and farmland birds. Additionally, the potential for the features to be included within existing or new agri-environment schemes is considered.

Wet habitat features

The WUFFB project involved the creation of replicate examples of a number of small-scale wet habitat features, chosen to reflect the types of features that most farmers could create on their land with minimal impact on their agricultural practices and production levels. All of the features were created on the Allerton Research and Educational Trust farm at Loddington or on neighbouring farms in the autumn of 2004.

First, 32 bunds were installed in existing ditches in order to retain water and create wet areas alongside both arable and pasture fields. These provided greater areas of permanent water and water at critical times during the year. Additionally, they may also lead to increased provision of damp soil. Ditches were a range of sizes in terms of length, width and depth and thus experimental plot size and extent of water created by the bund also varied. 16 bunds were installed alongside arable fields growing crops of winter cereals and oil seed rape. The depth of ditches ranged from just over 50 cm to 1.5 metres with bund width ranging from 1.5 metres to just over three metres. 16 bunds were installed in ditches alongside pasture used for grazing sheep, cattle, horses and cutting for silage. The depth of ditches ranged from 30 cm to just over 1.5 metres with bund width ranging from 1.4 metres to just over three metres.

Second, eight paired ponds were located alongside ditches and adjacent to both arable (winter cereals and oilseed rape) and pasture (sheep, cattle, horses, silage) fields. The upper pond is fed by water diverted from the ditch and the second pond is fed, via a vegetated buffer strip, from the first pond, before overflowing back to the ditch system. These ponds again provide areas of permanent water during critical times. The vegetative buffer strip catches the sediment from the flow of water between ponds with the additional possibility of herbaceous plant growth suitable as a food or nesting resource for farmland birds. The ponds varied in size from as little as five square metres to almost 50 square metres, with the inter pond bund width varying from 1.5 metres to almost nine metres. Maximum depth of the ponds ranged from 58 cm to 1.3 metres.

Third, 10 shallow surface scrapes, slightly deeper at one end, were incorporated onto existing set-aside or stewardship field margins to provide shallow pools and areas of damp soil. The scrapes are approximately 10 metres in length and three metres wide, with a maximum depth at one end of between 40 cm and 60 cm.

Finally, eight waterlogged areas, essentially rushy depressions in areas of pasture, were identified for observation in comparison with neighbouring dry areas. Three areas are spring fed, while five are fed by seepage. Half the feature in each area, both dry and wet, was fenced to exclude grazing livestock. Each section of each feature is, on average, about $100m^2$.

Methodology

To determine the impact on farm management, the analysis focused on: (i) the financial costs of establishing the wet habitat features in terms of capital investment, (ii) the financial costs associated with ongoing maintenance and repair of features, (iii) the costs associated with potential detrimental impact on farm income, and (iv) issues of practicality of the wet habitat options and their role within the farm system, including feedback from farmers from a wide range of farming backgrounds.

To determine the impact on farmland bird food resources and farmland birds, monitoring work over two years recorded the presence and successional change of aquatic and terrestrial vegetation, wetland and terrestrial invertebrates, and use of the created features by farmland birds. The sampling regime focused on (i) measuring the success in delivering open water, bare earth, sward heterogeneity and diversity of vegetation, as a measure of access to food resources for farmland birds, (ii) measuring the success in delivering (a) obligate wetland invertebrates and (b) terrestrial invertebrates, especially those important as a food resource for farmland birds, and (iii) measuring the use of wet areas in arable land and intensive grassland by foraging farmland birds. Table 1 indicates the monitoring work that was undertaken for each feature.

Table 1: Environmental Monitoring Work

	Vegetation	Terrestrial invertebrates	Aquatic invertebrates	Farmland birds
Ditches	✓	✓	✓	✓
Paired ponds	-	-	-	✓
Scrapes	✓	✓	-	✓
Waterlogged areas	[a]	[a]	-	✓

[a] *Monitoring of vegetation and terrestrial invertebrates were also undertaken on the waterlogged areas of pasture as part of various student projects. The results are not presented in this paper.*

The composition and structure of vegetation alongside both arable and pasture ditches and within the scrapes and their controls was assessed in both 2005 and 2006, during April and then July. Surveys of emerging aquatic insects, from April through to August, were undertaken on the arable and pastoral ditch features. Terrestrial invertebrate densities were also assessed on the arable and pastoral ditch features. Surface active invertebrates were assessed between May and July. In June and September sampling of sward canopy invertebrates was also undertaken. The surface scrape features were also assessed for surface active and canopy invertebrates. Finally, pilot bird monitoring was undertaken in January and February 2005 with complete monitoring of all sites beginning in mid-March. All bird activity was recorded including species, number, and length of visits.

Results

In terms of water retention, both arable and pastoral ditches generally worked as expected, with greater amounts of standing water retained within the bunded ditches relative to the controls. Similarly, the paired ponds also retained water with, perhaps surprisingly, little difference between the first and second ponds. However the surface scrapes did not hold water for any length of time.

Farm management implications

The main cost of establishment for the bunded ditches, paired ponds and scrapes is the time, labour and machinery costs associated with the use of a ditch excavator. Additionally, for the bunded ditches and paired ponds piping is required as an outflow in the bunded ditches and from the second of the paired ponds. In pasture, there is also the requirement to prevent livestock access with fencing around each feature. Relevant costs are given in Table 2. The following assumptions are made.

Labour use with regard to the creation of wet habitat features is based upon experience within the project. First, it would take one man and a digger one day to create three bunded ditches, that is about 2.5 hours per ditch. Second, in one day (7.5 hours) one man could create a paired pond. Finally, between eight and 10 scrapes could be created in a day using one man, that is about one scrape per hour. The wage rate assumed is £10 per hour.

The equipment used at Loddington was a 13 tonne JCB 360° excavator which would typically be used for ditch maintenance on many farms. Contractor costs would typically be £38 per hour for the hire of the excavator and £10 per hour for labour (Nix, 2006).

Piping costs depend on diameter and length. Pipes of 3m in length and 150 mm diameter were used on both the bunded ditches and the paired ponds. The cost per pipe is assumed to be £4.25 per metre.

Table 2: Cost of Feature Establishment [a]

Item	Ditch	Paired ponds	Scrapes
Digger @ £38/hr	£95.00	£285.00	£38.00
Labour @ £10/hr	£25.00	£75.00	£10.00
Pipe at £4.25/m	£12.75	£12.75	n/a
Total cost	£132.75	£372.75	£48.00

[a] *Data based upon standard figures from Nix, 2006.*

In addition to the costs in Table 2, the exclusion of livestock from features created in pastoral fields would be required with stock proof fencing. Materials and labour costs would be in the region of between £3.00 to £3.75 per metre (Nix, 2006). Fencing off ditch features would be dependant on length of retained water and ditch width. Estimates based on the experimental features suggest costs could range from less than £25 for around seven metres of fencing and up to £90 for around 24 metres of fencing. For fencing around paired ponds, costs range from as little as £70 for 18 metres of fencing and up to £170 for 45 metres of fencing.

Following on from establishment, the other main cost is that of ongoing maintenance and repair of features. The primary concern here is that of the arable and pastoral ditches. Over time, and as expected, the ditches accumulate sediment, more so in the case of arable ditches and following periods of heavy rainfall. Assuming current rates of accumulation, the need to clear the ditches of sediment would be required about once every four years. To some extent this is dependent on soil type and typography. Within a 10 year period, it might be the case that ditch maintenance would be required two years after initial establishment of the bund feature and associated disturbance, but then would not need to be done again for five years.

All of the features were established within existing field boundaries including set aside and stewardship margins. For the purposes of this exercise, the assumption is made that the land upon which the features are created is therefore not used for productive purposes and that no estimate of income foregone is required. However, it may be possible that land adjacent to the features may face reduced yields due to the increased wetness of the area within the vicinity of the features. To establish whether or not this was the case, arable yields for a range of crops in 2006 were taken from a single grid reference point nearest to the features and also their controls. Only data for the latter period of the project data was collected to allow time for the wet habitat features to have established and, at the same time, to exclude the first year and potential detrimental impacts associated with feature creation works undertaking during the first autumn of the project. The final data set consisted of information for eight arable ditches with four estimates for winter wheat, three for spring beans, and one for oilseed rape; 10 surface scrapes with eight estimates for oilseed rape and two for spring beans; and two paired ponds with an estimate for winter wheat and oilseed rape. Data was not available for features on the neighbouring farms used within the project. This makes it difficult to undertake thorough statistical analysis, however, certain inferences can still be drawn, primarily that the wet features do not appear, at least in the first years of establishment, to be having a detrimental impact on yield.

For the arable ditches, yield changes ranged from an increase of 1.48t/ha to a reduction of 0.88 t/ha with half the experimental plots showing an increase and half showing a decrease irrespective of crop type. It is a similar story for the surface scrapes, ranging from an increase of 0.85 t/ha to a reduction of –1.95 t/ha, and also the paired ponds with an increase in the wheat crop of 1.71 t/ha and a decrease in the oilseed rape crop of –1.18 t/ha. Obviously, given the paucity of data these figures should be treated with caution.

The bunded ditches at Loddington have been used as a focus for discussion with farmers about broad issues including those associated with providing foraging habitats for farmland birds. This has included over 200 farmers participating in Defra's VTS 'Pathfinders' project as well as other events organised by the Allerton Trust. Farmers from low lying areas, where there is a need to maximise drainage, were generally against the installation of the features on their farms. Farmers from mid and upper catchments found the features acceptable if there was to be sufficient payments for capital costs. A number of concerns were raised, including the potential interference with field drains, the need to know about and compensation for frequency of dredging, and the need for guidance on the disposal of sediment. These could easily be addressed in policy guidance. Finally, feedback from the neighbouring farmers whose land has been used to install some of the wet habitat features recognise that they do not interfere with their agricultural operations.

Environmental implications

Table 3 highlights the key findings regarding the vegetation, aquatic and terrestrial invertebrates and farmland bird species. The full data set for the monitoring undertaken in both years has yet to be fully analysed and will be reported elsewhere.

No significant differences in terms of the abundance of key plant taxa, important in the diet of birds, was found between the wet and dry ditch sections, nor was there any difference in vegetation height. However, the abundance of bare ground was greater in the wet sections than the control sections of the ditches in the first year of analysis but not in the second year. The first year differences probably reflect the disturbance associated with digging the bunds to create the wet sections of the ditch.

Vegetation height in the surface scrapes was significantly lower than that in the adjacent control areas reflecting the disturbance of the vegetation during creation of the features. Vegetation development is, however, evident with an increase in grass cover in the wet scrapes. Nevertheless, bare ground is still more abundant in the wet scrapes, with litter more abundant in the dry controls.

Table 3: Results from the Environmental Monitoring Work

	Vegetation	Terrestrial invertebrates	Aquatic invertebrates	Farmland birds
Ditches	No difference in abundance nor vegetation height. Greater area of bare ground on experimental plots.	No difference in abundance nor species richness.	More abundant in shallow water and damp mud associated with bunded ditches.	Probability of recording farmland bird higher in bunded ditches.
Paired ponds	-	-	-	Probability of recording farmland bird higher in paired ponds.
Scrapes	Vegetation height lower in scrapes than controls	Greater invertebrate mass in scrapes	-	Little difference between experimental and control plots.
Waterlogged areas	-	-	-	Little difference between experimental and control plots.

A progressive increase in emergent insect numbers was found throughout the sampling season (Aquilina et al., 2007), with the emerging insects observed to be most abundant where there is very shallow water and, particularly, newly exposed damp mud. The difference in the number and biomass of emerging insects produced by the bunded ditches and controls was greatest in June and July when most of the control ditches were dry, but many of the bunded ditches retained water or wet mud. Emerging insects were also common where there was accumulated leaf litter more typical of the control plots with their more mature substrates. There was no significant difference between the arable and pastoral bunded ditches. There is some suggestion that ditches with greater flow and less shade from over-hanging vegetation are better for emerging insects.

For both the arable and pastoral ditches, there was no significant difference between the treatment and control in terms of abundance and species richness for both the surface active and canopy invertebrates. In the scrapes there was a greater invertebrate mass when compared with the controls for the surface active invertebrates. However, it is not known whether this increase is a result of greater invertebrate movement due to reduced vegetation and thus the increased likelihood of being collected when compared with the control areas, or an actual increase in invertebrate numbers.

A wide range of farmland bird species was recorded, although, in the first year there was little difference between the experimental and control sites. The main difference was between the arable and pastoral ditches with bird encounter rates higher in the arable areas. To some extent the first year results are to be expected as the sites were still establishing and over the winter period there would be little noticeable difference with regard to the presence of water. Over time, into the second year and as the features established, the probability of recording a bird was generally higher in the bunded ditches and paired ponds than the control ditch sections. This was particular evident in early June and throughout August, although for the ditches the reverse was true for October.

Discussion and Conclusion

As the project draws to a close, it is evident that the vegetation is starting to respond to the wet habitat features. It is also evident that the wet features created for this project will take several years to mature. For example, where modification of existing features, such as with the bunded ditches has taken place, water retention has been good. This is not the case for newly created features such as the surface scrapes. It is possible that it may take several years for good seals to form, so enhancing the water storage capacity of the wet features.

Further, the waterlogged areas, which were in existence prior to the start of the project, demonstrate the potential of wet features. They have well established tussocky grass and rush areas, a better structural development of the vegetation and thus provide a better invertebrate resource and thus a very good source of bird food. It could therefore be suggested that the production of the invertebrate food resource within the newly established features could change in abundance and composition as the aquatic plant habitats and substrates mature.

Additionally, there is some evidence that farmland bird species may be responding to the wet features. A range of activities and behaviours was noted within the vicinity of the features, although, to be conservative, the results of the monitoring work reported here were only from within the features themselves. Similarly, there is also evidence that larger features and areas of water-logging and damp soil may also attract greater bird numbers.

In terms of policy support for such features, it is evident that there are significant costs associated with the establishment of such features, however, their impact on the farming system is minimal. This would suggest, if deemed appropriate, the need for some form of grant funding for the capital works associated with the establishment of the wet habitat features. Current environmental policy within England is at three levels. First, and in order to receive support from the EU via the Single Payment Scheme, farmers are required to cross comply with a number of Statutory Management Requirements and Good Agricultural and Environmental Conditions. Second and third, under the EU Rural Development Regulation, farmers can opt into an agri-environment scheme. In England, this is Environmental Stewardship (ES) with a five year Entry Level (ELS) for fairly simple and effective (beneficial) land management and a 10 year Higher Level (HLS) focused on more demanding, complex and targeted environmental management including capital works. The key aim of ES is to secure environmental benefits at levels above those of Good Farming Practice and cross-compliance conditions. Of the features outlined in this study, the bunded ditches, paired ponds and surface scrapes would most likely fit within HLS, with the provision of payments for capital works, and particularly given the need to allow some length of time for feature establishment. The fencing of existing waterlogged areas, if deemed appropriate, would perhaps come under ELS. Consideration would need to be given to payment rates and guidance on feature establishment including the most appropriate period within which to create the features bearing in mind both farm management and environmental requirements.

In conclusion, despite the significant costs associated with feature creation and limited evidence of immediate environmental benefit, it is suggested that the short term nature of the project does not allow for concrete environmental results to be established. What can be said is that the features are successful in increasing the quantity of the wet habitat resource, and that given time, it is also likely that an increase in farmland bird food resources and farmland birds would become more evident.

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