Creating and Managing Grassland for Breeding Waders on the Lincolnshire Coastal Grazing Marshes

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Introduction

A three-year study into the reasons for success in attracting breeding waders to sites converted from arable land to grassland in the Lincolnshire Coastal Grazing Marshes (LCGM) has produced results with wide-ranging applications.

The low permeability soils and substrates in this area limit lateral groundwater movement to such an extent that wetness of a site depends almost entirely on how successfully water can be retained on the surface, often perched above the groundwater level. The level of water in surrounding ditches has little effect.

Site design is critical. As a result of the low permeability of the soils, it is possible to create scrapes from which water will gradually evaporate and which will be topped up effectively following rainfall. Linear channels, similar to historic patterns of ridge and furrow, provide a greater length of margin with soft ground suitable for waders to feed than do rounder scrapes and pools.

The ability of a site to retain water is also critical and this requires effective sealing of the field drains which enhanced the previous arable land use. Although it might be difficult to find all old drains. If any continue to operate, retaining water in scrapes and other surface features is problematical.

Site management, particularly grazing levels, is also critical as sward height and tussock density is important to breeding success. On fertile sites, the grazing intensity prescribed in agri-environment schemes may not be sufficient to achieve the optimum sward height.

The findings of this study should make a useful contribution to design of new environmental land management schemes and their indicators of success.

Background

The Lincolnshire Coast and Marshes National Character Area runs from the Humber to the Wash. The two estuaries are designated European Marine Sites and are of particular importance for the populations of birds they support, including significant assemblages of wading birds.

Lying between the Lincolnshire Wolds and the North Sea is the coastal plain known as the LCGM. Remnants of historical management are the fine examples of ridge and furrow grassland, which demonstrate a long history of mixed farming. However, until the mid-20th century, grassland predominated.

Water levels within the marshes have been managed for centuries. Sluices and staunches allowed movement of water from the raised main rivers into networks of ditches. The water stimulated grass growth, was used by livestock for drinking, and the ditches acted as wet fences. The first pumps were installed in the 1850s at Gayton Engine, but the modern era began after the 1953 east coast floods. From then on, highly efficient pumps have been installed and the emphasis has switched from provision of additional water for summer grazing to drainage to improve arable productivity. Inflow of water from main rivers ceased in the 1970s, however a legacy is the current practice of slightly raising water levels in Internal Drainage Board watercourses over the summer months for environmental reasons.

Concern over the changing landscape, with loss of grassland and the bird life it supports, led to the formation of the LCGM partnership in 2004. The partnership's vision is:

"The Lincolnshire Coastal Grazing Marsh will once again have extensive grassland landscapes rich in wildlife, intersected by a distinctive pattern of water courses. Within this landscape, pastoral farming thrives and local communities have a high quality of life. The area is attractive to local people and visitors, with year round opportunities to experience the natural and historic environment through improved access, helping to develop and sustain a vibrant rural economy." (LCGM 2006)

Since 2004, the partnership has gained funding for research and provision of advice to farmers, culminating in a Landscape Partnership grant from the Heritage Lottery Fund for a £1.7 million project that started in the autumn of 2011.

Although the LCGM were not selected as one of the early Environmentally Sensitive Areas, incentives to maintain, restore or

create grazing marsh have been available since the 1990s. One arable reversion site, supported through the Countryside Stewardship Scheme, is of particular interest, with peak numbers exceeding two pairs of breeding waders per hectare and supporting the largest concentration of breeding lapwing in the county.

When Higher Level Stewardship (HLS) was introduced in 2005, evidence supplied by the partnership supported inclusion of the Lincolnshire Coast as a Target Area for breeding and wintering waders and wildfowl. Introduction of HLS resulted in more funding being allocated for 'creation of wet grassland for waders' which, in this locality, can be interpreted as restoration or creation of functioning grazing marsh.

Concerns over allocation of resources to re-establishment of grazing marsh

The Lindsey Marsh Drainage Board, the main Internal Drainage Board operating in the area, had concerns over the impact of large areas of new grazing marsh on the function of catchments. Raised water levels have the potential to increase flood risk.

In addition, concern was also being expressed that measures taken to create wet grassland for waders were not always successful and questions were being asked about value for money. As a result of these concerns, Natural England supported a research programme; funded through the HLS scheme and undertaken by JBA Consulting between 2009 and 2012.

The scope of the study

The JBA study focused on three recently established wet grassland creation sites, two of which were perceived to be 'successful' while anecdotal evidence suggested that the third was not attracting wetland birds to the same extent. A control site on arable land was also included. The study was designed to identify the reasons for success and to understand and explain the causes of any identified differences. The findings were expected to inform design of future projects and assess any changes to flood risk.

Monitoring studies were undertaken on all the sites between 2009 and 2012 to look at the following parameters:

- water levels on the sites and in the surrounding drains;
- soil hardness;
- rainfall;
- vegetation height and composition; and
- use of sites by birds, particularly target species.

The study sites

The four sites – Saltfleetby, Bratoft, Middle Marsh and Control – are all underlain by relatively impermeable clay soils. The three reversion sites differ in their design (i.e. the means by which they were expected to hold water). Earth movement at the Saltfleetby site created features which can be described as wader scrapes with scattered rounded pools; within the Bratoft and Middle Marsh sites a ridge and furrow pattern was created with linear channels, scrapes and pools. The linear channel design collects surface run-off effectively and maintains an extensive wet margin. The Natural England Indicators of Success for the sites differed, but the critical issue was whether the sites were sufficiently

	Saltfleetby Figure 1	Bratoft	Middle Marsh Figure 2	Control
Size	100ha	23ha	72.5ha	21ha
General description	Flat, low-lying pasture c.1km from coast at Saltfleet (Humber Estuary Natura 2000 Site)	Flat, low-lying pasture 7.2km from the coast (The Wash and North Norfolk Coast Natura 2000 Site)	Flat, low-lying pasture 3.6km from the coast (The Wash and North Norfolk Coast Natura 2000 Site)	Two fields of arable land, c.1km from the coast at Saltfleet (Humber Estuary Natura 2000 Site).
Scheme type	HLS	CSS	HLS	N/a
Timing of preparatory earth works	May-Oct 2007	Oct 2003 – May 2004	2007 – March 2008	N/a
Description of earth works	Creation of wader scrapes, ranging from small rounded ones to several elongated larger scrapes (maximum length 70m), in a relatively ad hoc arrangement. Field drains were blocked, but some remained intact, allowing continued drainage of the upper layers of soil and the scrapes contained within them.	Creation of a ridge and furrow pattern containing 18 long linear channels/scrapes in a grid and additional pools. Land drains were sealed and concrete sluices fitted to retain water on site.	Creation of a ridge and furrow pattern containing long linear channels/ scrapes and additional pools. The scrapes differ from those at Bratoft by being connected in a tiered system, with 15 discrete hydrological units, connected to a central water channel to direct and control discharges through two outflow weirs. Land drains were sealed.	N/a

Figure 1. The 100ha Saltfleetby study site on 23rd April 2013, showing scrapes and pools. Not all of these are holding water, primarily because unsealed field drains remain. Saltfleetby - Theddlethorpe Dunes NNR and the Humber Estuary Natura 2000 site lie beyond the study site (within 1km). Photo by © R. Wardle

Figure 2. The 72.5ha Middle Marsh study site on 23rd April 2013, showing the network of linear channels, scrapes and pools within 15 discrete hydrological units. The surface features, with extensive damp margins, are holding water effectively. The Wash and North Norfolk Coast Natura 2000 site can be seen in the distance (closest point 3.6km). Photo by © R. Wardle

wet to attract and retain breeding wetland birds. The sites had the following main features:

Outline of the Studies

The hydrological elements of the study aimed to produce conceptual models to understand how water moves through the sites and produces (or does not produce) suitable habitat conditions for the target bird species. This work involved desk studies, site walk-overs, hand auguring, creation of boreholes, and installation of gauge boards, stilling wells and rain gauge monitoring arrays which collected data over a three-year period.

Soil hardness (as a proxy for ability of beaks of wading birds to penetrate the soil to feed) was measured using a penetrometer. Rain gauges were used to measure rainfall.

Vegetation was monitored in fixed quadrats. Bird numbers were monitored using a series of point counts and transects (recording from vehicles to avoid disturbance).

Key findings

Hydrology. The sites are all mostly underlain by low permeability clay or silty clay salt marsh and tidal creek deposits, which limit the rate of lateral groundwater movement. The hydrological conceptual models (see Figure 3) revealed the following key points:

- Because the soil and substrate limits lateral movement, water levels in drainage channels have little influence on groundwater levels within the sites (except very close to channels).

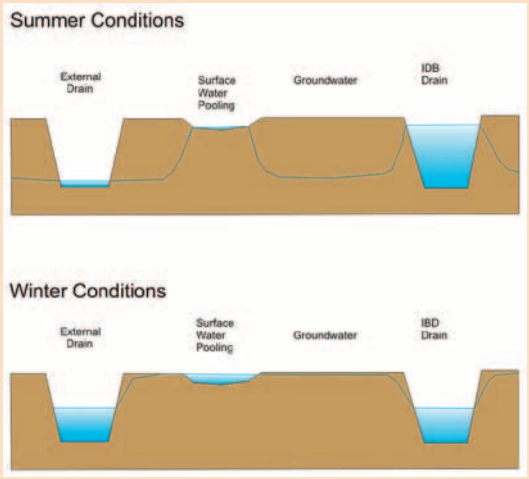

Figure 3. Schematic cross-section across an arable reversion site illustrating how water levels in external drains have little effect on groundwater level. In summer, evapo-transporation causes groundwater levels to drop. Recharge is primarily from rainfall. © JBA Consulting

- Evapo-transpiration and recharge (primarily rainfall) are the main factors controlling groundwater levels.
- Groundwater levels only require small amounts of recharge to rise significantly because of the low specific yield of the clay.

Flood risk. Multiple factors influence peak discharges and the report included discussion of changes in run-off path length, changes in overall storage due to scrapes and the degree to which those scrapes are at capacity (i.e. amount of storage available). The way in which individual wetland reversion schemes affect the catchment drainage network, and thus flood risk, will vary depending on the design of the scheme and, to some degree, the position in the catchment.

Soil hardness. Except within scrapes where there was standing water, no site had soil damp enough for a six-inch nail to be pushed into the ground with ease between 1st April and 30th June as specified as a positive indicator in current HLS agreements.

Rainfall. The study period coincided with a period of climatically atypical, below average rainfall at all four sites. The continuing dry conditions led to the decision in spring 2012 to abstract water from adjacent watercourses (under licence) to fill the low-lying areas of the grassland sites. Without this it was considered that some key wetland birds would not breed successfully. Shortly after the augmentation, a very wet spring and summer commenced (recorded rainfall in April and June at Saltfleetby were 195% and 264% above the average respectively). Despite the atypical records over the study period, it was possible to draw strong conclusions.

Vegetation. The results showed that the swards across the three study sites were fairly similar, being mainly MG6 and MG7 type grasslands. The classification did not change much during the recording period, however, there were small-scale changes on an annual basis, probably related to variations in grazing pressure and weather conditions.

Birds. The JBA study demonstrated that three target species – lapwing, redshank and snipe – were present in statistically significant greater numbers throughout the three years of the study on the Bratoft and Middle Marsh (ridge and furrow) sites compared with the Saltfleetby and Control sites. Lapwing and redshank bred in significant numbers on the Bratoft and Middle Marsh sites, along with avocet. There were no breeding records for any of these species on the Saltfleetby and Control sites throughout the three-year study. Further recording in 2013 found snipe breeding on the Middle Marsh site, bringing the total of breeding wader species to seven. For curlew, a non-breeding wader species, there was no statistical difference across the sites during the JBA study.

In comparing the Saltfleetby and Control sites, there was no statistical difference between the numbers of lapwing, redshank and snipe.

Duck records for mallard, teal and wigeon on all four sites were also analysed. The results showed that there were significantly more of these species at Bratoft and Middle Marsh than at Saltfleetby.

Scheme design

Because of the low permeability of the substrate, scheme design and earth works are particularly important in terms of the ability of a site to capture and hold water on the surface. Suitably wet conditions for target species cannot be achieved effectively by raising external ditch water levels. Key points for success were:

- The ability to collect rainfall run-off within surface features, retain it within these scrapes and pools and maintain a long wet margin through a range of water levels.
- The most effective design is a linear channel (ridge and furrow) pattern with scrapes (and pools) with a good catchment-size to scrape-size ratio. This creates and maintains a long wet margin due to its shape and cross section, whether full or nearly empty.
- The creation of long margins through a range of different water levels is important in creating and retaining suitable habitat throughout the wader breeding period.
- The best scrapes were created in very low permeability ground. Where scrapes (and pools) were created in sandy clays (e.g. parts of Middle Marsh) or where there were effective field drains (e.g. parts of Saltfleetby), water within scrapes was more easily lost to the surrounding ground. Where scrapes were in very low permeability ground, water levels in the scrapes could be perched above the surrounding groundwater levels, allowing them to survive longer into the water budget deficit period.
- The nature of the groundwater response to recharge and to water levels within external drains was changed significantly by the presence of effective field drains. These acted to quickly drain the upper layer of the clay (providing water levels in the external drains created a suitable hydraulic gradient).

The findings of this work are likely to be applicable to other wet grassland areas with similar soil types (low permeability soils and substrates).

The bird surveys demonstrate that in terms of attracting target species to breed and meeting Environmental Stewardship Indicators of Success, the Bratoft and Middle Marsh sites have been significantly more successful than the Saltfleetby or Control sites. The reasons for this revolve around the dryness of the Saltfleetby site resulting primarily from continued drainage of the upper soil zone and scrapes as field drains remained functional. It is anticipated that implementation of improvements suggested by these studies would result in the Saltfleetby site being colonised by breeding waders.

Site management

Grazing management is also critical to successful breeding by waders. Literature reviews (e.g. Hart *et al*. 2002) suggest that grazing by livestock throughout the breeding season at low densities – 0.2-0.5 livestock units per hectare (LU/ha) – appeared to maintain the sward and resulted in few nest losses through trampling. Beintema and Muskens' (1987) model shows that a stocking rate of 0.5LU/ha will allow a hatching success of between 80% and 90% for lapwing, around 70% for oystercatcher and close to 90% for redshank.

Not surprisingly, current HLS agreements specify low stocking densities of 0.75LU/ha during the breeding season, yet local experience shows that on nutrient rich former-arable and intensive grassland sites these guidelines need adjustment. A better measure of the correct stocking rate would be sward height, especially from early-March to late-May. Sites vary as do seasons, but for the target species in this study (particularly lapwing and redshank) a short sward with occasional tussocks appears to produce conditions suitable for successful breeding. To achieve this, stocking rates up to 2LU/ha may be required on some sites.

Indicators of Success

In light of the results of the hydrological conceptualisation of the sites, the suitability of the Higher Level Stewardship Scheme (HLS) Indicators of Success for *HK13 -Creation of wet grassland for breeding waders* have been reviewed. This review showed that some indicators appear to be based on the concept that conditions for target species will be created through a general raising of groundwater levels across a site. However, suitable conditions were created on the best sites within the study through the collection of run-off into linear scrapes.

With limited lateral groundwater movement, soft soil is confined to scrapes and their fringes. The penetrometer test indicator, developed for peat soils, is unsuitable for low permeability clay sites. Assessments presented in the study report should be informing the development of indicators for new environmental land management schemes.

Figure 4. The Middle Marsh study site showing linear channels in a 'ridge and furrow' pattern. As water levels drop, the channels retain a long 'edge' with soft soil conditions suitable for waders to feed. Cattle maintain a sward height suitable to attract birds in spring and provide the conditions for nesting. Photo by © R. Wardle

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All three authors have been involved in the Lincolnshire Coastal Grazing Marshes Project since its early days and both Lindsey Marsh Drainage Board and Lincolnshire Wildlife Trust belong to the partnership.