

5. Biological evaluation of the grazing marsh resource

5.1 Introduction

The present project aimed to characterise the grazing marsh resource in England using biological criteria. To achieve this, it was important to know which plant and animal species occurred on different areas of grazing marsh. Work by Dargie (1993) identified the distribution of the grazing marsh resource in most of the country, but there is no corresponding comprehensive inventory of the plants and animals occurring in these parcels of land. The biological quality of grazing marsh was therefore evaluated by incorporating other national species data-sets. These data-sets are held within the *Grazing Marsh GIS*, created in previous research (Roy *et al.*, 1998), augmented during the present project, covering ornithological, botanical and invertebrate species groups (see Chapters 3 and 4).

The biological quality of grazing marsh areas was evaluated within the framework of English Nature Natural Areas (Anon, 1996). Although the use of national species data-sets allowed the quality of each grazing marsh area (Dargie polygon) to be evaluated, it was decided that setting targets for restoration would be more appropriate within a regional framework. This initial targeting based on six biological attributes was subsequently refined using information on a) extant and proposed restoration schemes (see Chapter 6) and b) potential wet grassland areas defined using data on liability to flood, altitude and land cover (Chapter 7).

5.2 Integration of botanical and zoological data-sets

The evaluation of lowland wet grassland sites already conducted using botanical data-sets (Roy *et al.*, 1998) was repeated using similar methods for each of the zoological data-sets. The data-sets are detailed in section 4 (and Appendix 1) of the present report, and were used to derive six measures (3 ornithological, 2 botanical and 1 entomological) of the biological quality of grazing marsh areas detailed in section 4.3.2.

5.3 Relation to English Nature Natural Areas

The *Grazing Marsh GIS* was then used to relate these site evaluations to EN Natural Areas. For each Natural Area, a mean value was derived for each of the six quality measures *i.e.* a mean of the Dargie polygons wholly or partly within each Natural Area. Grazing marsh areas locally straddle Natural Area boundaries, and in such instances the scores were weighted by the area of marsh within each Natural Area. Finally, a composite measure of quality was derived for each Natural Area, by taking an overall mean across the ranks of the six individual mean values and obtaining a Natural Area rank. This approach enabled important Natural Areas for grazing marsh to be identified in terms of both quality and quantity (total area of resource). Comparison of these two rankings was used to inform where restoration should be targeted. For example, those Natural Areas with a large area of relatively low quality grazing marsh were judged most in need of habitat rehabilitation.

Table 1 gives a summary of the 6 biological quality measures for each Natural Area. Part 1 provides the actual values for each attribute whilst Part 2 presents a ranking of the Natural Areas for each of the six attributes. Part 3 presents three summary rankings:

- **Mean and final biological rank** *i.e.* the overall ranking of the Natural Areas in terms of a combination of the biological quality attributes.
- **Marsh area rank** *i.e.* a ranking of the Natural Areas on the basis of the total area of “lowland wet grassland” within each Area, as mapped by Dargie (1993, 1995), amended using additional data from the FRCA on marsh area (see Appendix 3).
- **Rank comparison** *i.e.* the biological rank number minus the Dargie rank number (see section 5.4.3 for the meaning of this value).

A pictorial summary of the results from Table 1 is provided by figures 1-5. Figures 1-3 summarise the values of the six attributes for each of the English Natural Areas. Figures 4 and 5, provide two examples of the type of information available for Dargie polygons throughout England, showing information on **a**) rare and scarce plants and wildfowl species richness for the Somerset Levels and Moors (Figure 4); and **b**) invertebrate species richness and breeding wader density for the Romney Marshes (Figure 5).

5.4 Preliminary Selection of areas for restoration

5.4.1 Ranking by biological quality attributes

Examination of Table 1 and Figures 1-3 provides an initial assessment of those Natural Areas where restoration of coastal and floodplain grazing marsh might be most appropriate. Different biological attributes stress different Natural Areas, though certain Natural Areas are highly-rated by all or most of the six quality measures.

1. **Wildfowl importance scores (WeBS counts)** *i.e.* the sum of the importance scores (regional, national and international) for wintering wildfowl recorded within 1km of a Dargie polygon, expressed as a national rank and summed across each Natural Area. There is huge variation in the value of this attribute *i.e.* \$ 10000 for certain coastal and floodplain areas (*e.g.* Greater Thames Estuary, Trent Valley and Rises, Suffolk Coast and the Broads), but <100 for some upland Natural Areas. Those Natural Areas where wetland bird populations were highest, and most important as a proportion of the regional, national or international population, are almost all coastal and/or with significant land area <50m A.O.D.. In the majority of these areas, grazing marsh remains (or has historically been) a major landscape type. In addition, the Cumbria Fells and Dales support relatively high populations of wintering waterfowl, despite grazing marsh being confined to a relatively small coastal zone:

Greater Thames Estuary	Humberhead Levels	Lancashire Plain
London Basin	New Forest	North Norfolk
Romney Marshes	Solway basin	Somerset Levels and Moors
South Coast Plain <i>etc</i>	South Wessex Downs	Suffolk Coast and Heaths
Tees Lowlands	The Broads	The Fens
Trent and Avon vales	Trent Vale and Rises	Urban Mersey Basin
West Anglian Plain	West Cumbria Coastal Plain	

2. **Absolute numbers of species (WeBS counts)** *i.e.* total number of wetland bird species recorded in each 5km buffered Dargie site, averaged across each Natural Area (Figure 1B). This species-richness value shows rather less apparent variation *i.e.*

generally between 10 and 40. Natural Areas rich in wetland bird species are again all coastal and predominantly lowland. Important blocks of grazing marshes survive in most of these Areas, or were present until relatively recently:

Northumbria Coal Measures	North Norfolk	Tees Lowlands
Vale of York and Mowbray	The Broads	Greater Thames Estuary
Romney Marshes	Lancashire Plain	Suffolk Coast and Heaths

Other species-rich Natural Areas have a more varied landscape but with important (if smaller) grazing marshes: High Weald, Isle of Wight, Exmoor, New Forest and the Devon Redlands.

3. **Density of 5 breeding waders of wet meadows** *i.e.* total number of pairs of breeding waders recorded in each 5km buffered Dargie site divided by its area (km²), averaged across each Natural Area (Figure 2A). Those Natural Areas with sizeable populations of Curlew, Lapwing, Oystercatcher, Redshank and Snipe include not only the major grazing-marsh blocks, but also several areas (Forest of Bowland, Pennine Dales Fringe, and Cumbria Fells and Dales) that reflect the range of wet habitats, including moor and bog, used by some of these species for nesting. Many of the highly-ranked Natural Areas were those also identified through the *WeBS*-derived attributes:

Vale of York and Mowbray	The Fens	Greater Thames Estuary
The Broads	Humberhead Levels	Wealden Greensand
High Weald	New Forest	Tees Lowlands
Suffolk Coast and Heaths	Cumbria Fells and Dales	

Two further Natural Areas (South Downs and South Coast Plain) were also identified as supporting relatively high densities of breeding waders.

4. **Actual number of rare/scarce plant species** *i.e.* the total number of nationally rare or nationally scarce plants with 1km or 0.1km records within Dargie sites, averaged across each Natural Area (Figure 3A). Those Natural Areas shown as having a large number of rare or scarce plants are all south and east of the Severn-Humber line, reflecting the well-known gradient in biodiversity in Britain from south to north. Several Natural Areas are highlighted which have greater topographic variation but lie directly adjacent to Areas with large blocks of grazing marsh *e.g.* Mid Somerset Hills, Mendip Hills and Bristol (with Avon Valley and Ridges). There is an apparent trend toward Natural Areas in the south-west of England – in addition to those already mentioned: Somerset Levels and Moors, Exmoor, Vale of Taunton, New Forest, Wessex Vales and the Dorset Heaths. Major flatlands with a variety of rare and scarce wetland plants include:

Somerset Levels and Moors	The Broads	The Fens
Greater Thames Estuary	Romney Marshes	Suffolk Coast and Heaths

5. **Potential average quality (weighted) of all plant species** *i.e.* average quality (as indicated in Mountford *et al.*, 1998c) of each Dargie site for all grazing marsh species that intersect the site, averaged across each Natural Area (Figure 3B). Of those employed, this quality measure showed the least variation (range: 4.29-5.65). The apparent low discriminatory power may reflect poor precision in locating many plant records to a particular Dargie polygon (and also Natural Area). Many of the more

common wetland plants are much less specific to grazing marsh, occurring in a range of wetland habitats which are represented throughout England. Among the Natural Areas with the highest potential quality score are some that were ranked relatively poorly using other criteria *e.g.* Yorkshire Dales, Breckland, East Anglian Chalk and North York Moors. Apart from Breckland, none of these have genuine grazing marsh landscape. However, most of the Natural Areas with higher values of **pwgtqual_mn** were ranked highly by the other quality attributes, and contain some coastal or floodplain grazing marsh:

Eden Valley	Cumbria Fells and Dales	The Broads
West Cumbria Coastal Plain	Solway Basin	Exmoor
Dorset Heaths	New Forest	Wealden Greensand
South Downs	Vale of York and Mowbray	North Norfolk

6. **Absolute number of invertebrate species recorded** *i.e.* total number of (selected) insect species recorded in each 1km buffered Dargie site, averaged across each Natural Area (Figure 2B). With the exception of three Natural Areas in East Anglia (Fens, Suffolk Coast and Heaths and the Broads), all Areas ranked highly on insect-richness lie on or south of the Bristol Channel and Thames Estuary. As with flowering plants, this trend is almost certainly determined by the south-north gradient in English biodiversity. Values for the attribute in these southern Natural Areas may be >10, whereas in otherwise highly-ranked Areas from northern England, typical values for **invert_tot_rich_mn** are between 2.38 (Solway Basin) and 8.03 (Cumbria Fells and Dales). As with vascular plants, some of the insect species used in the quality evaluation occur in other wetland habitats (*e.g.* wet heath and bog) as well as grazing marsh. This may explain the high ranking given to some lowland southern sites where grazing marsh is limited and generally coastal. The highest ranked Natural Areas are:

Low Weald and Pevensey	South Devon	Somerset Levels and Moors
Exmoor and the Quantocks	Mid Somerset Hills	The Fens
Greater Thames Estuary	Romney Marshes	Dorset Heaths
Bristol, Avon Valleys <i>etc</i>	New Forest	Suffolk Coast and Heaths
North Kent Plain	South Downs	The Broads

Overall ranking

Combining these six individual rankings provides an indication of those Natural Areas possessing the overall attributes of high quality grazing marsh (Table 1, Part 3). However, since this biological ranking does not take account of flooding regime and topography, there remains some blurring of the distinction between true grazing marsh habitat and other wetland habitats and landscapes. The fifteen highest-ranked Natural Areas are as follows:

*The Broads	*The Fens	+New Forest
*Vale of York and Mowbray	+Wealden Greensands	*North Norfolk
*Suffolk Coast and Heaths	+South Downs	*Greater Thames Estuary
*Romney Marshes	+Exmoor and the Quantocks	+North Kent Plain
+Dorset Heaths	*Somerset Levels and Moors	+Cumbria Fells and Dales

Two broad groups may be distinguished: **a)** Natural Areas where the general landscape is (or was before intensification of drainage/agriculture) grazing marsh (indicated *); and **b)** other Areas (indicated +) where grazing marsh is of limited extent (mainly

coastal) or where “grazing marsh species” occur in other wetland habitats. Other Natural Areas with a high overall biological quality rank are Humberhead Levels, Solway Basin and Tees Lowlands.

This overall ranking shows those Natural Areas which presently have the richest grazing marsh habitat, or which possess the majority of the “building blocks” from which grazing marshes might be restored. However, this is not necessarily the same as a priority ranking for grazing marsh restoration, rather it lists those Natural Areas where restoration schemes are likely to be successful simply because the biological components of that habitat are already present. It should also be emphasised that the greatest percentage biodiversity gain from habitat restoration may be realised where the present quality evaluation is low. Refinement of this biological ranking can be made using hydrological and land-use criteria (Chapter 7).

5.4.2 Ranking by area of lowland wet grassland

The Natural Areas of England were ranked on the basis of the amount of lowland wet grassland that was mapped by Dargie (1993, 1995). It should be remembered that Lincolnshire was omitted from the original survey, and that the amount of Lincolnshire data in the *Grazing Marsh GIS* remains relatively low. However, from this ranking it is possible to identify those Natural Areas with apparently the most extensive lowland wet grassland, regardless of actual biological quality:

<u>Somerset Levels and Moors</u>	Severn and Avon Vales	Lancashire Plain
<u>The Broads</u>	<u>Greater Thames Estuary</u>	Solway Basin
<u>Cumbria Fells and Dales</u>	West Anglian Plain	Trent Valley and Rises
Thames and Avon Vales	Humberhead Levels	<u>The Fens</u>
<u>Romney Marshes</u>	Low Weald and Pevensy	Mid Somerset Hills

Six Natural Areas (underlined) are highly ranked in terms of both biological quality and area of habitat, and may be regarded as containing the “core” English grazing marsh areas.

5.4.3 Comparison of biological and area rankings

As discussed above, such biological and area rankings assessed in isolation do not necessarily demonstrate where restoration effort is most urgently required. Table 1 (Part 3) includes a direct comparison of the rankings based upon biological quality and area. This comparison was simply achieved by subtracting the Dargie rank number from the biological rank number. The tabulated values may be broadly interpreted as follows:

- Where the **rank comparison value** is **negative**, the biological quality is relatively higher than might be expected from the extent of the habitat, and rehabilitation of grazing marsh may therefore be of apparently lower priority (but see section 5.4.4).
- Where the **rank comparison value** is **positive**, the biological quality is relatively much lower than might be expected from the extent of the habitat (*i.e.* there are extensive areas of low-quality grazing marsh) and rehabilitation of grazing marsh may be more necessary.

Using this rank comparison, certain Natural Areas may be provisionally selected as meriting rehabilitation of grazing marsh:

<u>Vale of Pickering</u>	Needwood <i>etc</i>	? South Wessex Downs
West Anglian Plain	Trent Valley and Rises	Severn and Avon Vales
Cotswolds	<u>Holderness</u>	East Anglian Plain
? Derbyshire Peak Fringe	<u>Lancashire Plain</u>	Midlands Clay Pastures
<u>Mosses and Meres</u>	Devon Redlands	<u>Humber Estuary</u>
? Shropshire Hills	? Dark Peak	<u>Solway Basin</u>
Thames and Avon Vales		

For certain Natural Areas (indicated ?), the magnitude of the positive rank comparison value may be an artefact, reflecting confusion between “wet grassland” in the broad sense, and that lowland wet grassland typical of the grazing marsh landscape. However, comparison of this list with maps of surface drainage channels (Marshall *et al.*, 1978) focuses attention on Natural Areas (underlined) where the drainage infrastructure typical of grazing marsh is in place, and yet where the habitat quality is poor. These Areas would be prime candidates for grazing marsh restoration, and the approach is further developed using data on liability to flood, altitude and land-cover in Chapter 7. Recent work by EN Grantham (*pers. comm.*) suggests that the North Lincolnshire Coversands *etc.* and Lincolnshire Coast/Marshes should be added to the list of targeted Natural Areas since both area and biological rankings were affected by inadequate data. Rehabilitation of lowland wet grassland in four Natural Areas may require restoration (or new construction) of an extensive drainage network: Severn and Avon Vales, Thames and Avon Vales, Trent Valley and Rises, and West Anglian Plain.

5.4.4 Target Natural Areas for Grazing Marsh Restoration

It is clear from this evaluation of the grazing marsh resource that there are two broad approaches that might be adopted in targeting Natural Areas for habitat restoration. Firstly, emphasis might be placed on those Areas with the greatest likelihood of success for a restoration scheme. Such areas would mainly comprise those achieving the highest overall biological ranking and containing a well-developed surface drainage network, as well as having the institutional framework in place to stimulate and fund habitat restoration (*e.g.* Environmentally Sensitive Areas - * below) *i.e.*

The Broads	The Fens	(*) North Norfolk
* Suffolk Coast and Heaths	* South Downs	* Greater Thames Estuary
Romney Marshes	* Somerset Levels and Moors	* Cumbria Fells and Dales
Vale of York and Mowbray		

The second approach would place greatest stress on those Natural Areas where there is evidence of the most severe decline in the extent and quality of grazing marsh. Areas which have suffered such decline can be identified both by examining the maps (Figures 22-28) included within Mountford *et al.* (1997), and through compilation of historical accounts (*e.g.* Mountford, 1994). An important pragmatic *caveat* might be applied to such a selection procedure. Among the Natural Areas with much poor grazing marsh, some may be intrinsically poor for natural biogeographic reasons. Still others may have been so degraded that there remain no high quality nuclei from which the “building block” taxa of high quality grazing marsh might spread to the surrounding landscape, following the creation of suitable hydrological and agricultural management conditions. In other words, one might create the

circumstances for rehabilitation, but if the closest specialist plants and invertebrates of grazing marsh are many 10s of kilometres away, such management effort may be wasted.

Therefore within those areas containing mostly low quality grazing marsh, the selection of priority areas for restoration may be partly refined by assessing the Natural Area to ascertain whether there remain a sufficient number and/or distribution of these biodiversity “hot spots” (high quality nuclei) to facilitate the rehabilitation of the surrounding landscape. Use of such a review of the candidate Natural Areas, based primarily on designated sites (SSSI *etc*) and ornithological criteria, focused attention on the following areas, where the greatest relative gains in biodiversity might be achieved:

Holderness	Humberhead Levels	Lancashire Plain
Lincolnshire Coast and Marshes	London Basin	Mosses and Meres
North Lincolnshire Coversands <i>etc</i>	Severn and Avon Vales	Solway Basin
Thames and Avon Vales	Trent Valley and Rises	West Anglian Plain
Vale of Pickering		

Although the results of adopting either one approach or the other are assessed in this report and discussed at length, the decision as to which of these philosophies should underpin habitat restoration policy is essentially for the conservation institutions (EN, CCW, SNH *et al.*) to decide. Finally, it must be acknowledged that successful restoration may depend on the active and enthusiastic co-operation of many bodies with different interests. Where such momentum already exists, the Natural Areas concerned might well assume a higher priority for restoration activity *e.g.* Severn and Avon Vales, and Vale of Pickering. This selection of Natural Areas was reviewed using data on flood liability *etc* (section 7.2.2) and the 23 Areas identified here formed the core of the land targeted for restoration of grazing marsh.

6. Collation and evaluation of extant and planned schemes

6.1 Methodology

In order to set restoration and re-creation targets for each of English Nature's Natural Areas, it was necessary to assess what efforts were already under way, or planned, to either rehabilitate or re-create coastal and floodplain grazing marsh. Having identified schemes, it would then be possible to estimate how far they collectively met the targets of the costed Habitat Action Plan (cHAP). Need for further action could then be estimated and its locations targeted with greater precision. Hence as part of the present study, a survey of existing schemes and planned activity was conducted by the ITE, with co-operation from the partners in the Steering Group for the cHAP. A simple questionnaire was drafted (Appendix 2A) and circulated firstly to EN regional offices and to nominated offices of FRCA and RSPB. Recommendations from this initial survey led to the ITE contacting certain offices of Wildlife Trust and local authorities *etc* for further information. Within the time-span of the present project, the survey could but be preliminary and incomplete, requiring collation of further responses as they continue to be submitted. Appendix 2B lists all those offices to have been included in the survey.

The survey was designed to provide a simple summary of schemes, without excessive detail. The fundamental data required to meet the objectives of the project were:

- **Site location** – so as to be able to cross-reference against the *Grazing Marsh GIS*.
- **Area** – so as to assess its contribution to cHAP targets.
- **Project type** – did the scheme contribute to rehabilitation or re-creation targets?
- **Time scale** – was the scheme under way, planned with a firm initiation date, or as yet part of general unconfirmed planning in the area?

Additional information was gathered using this questionnaire to provide some indication of the eagerness of land-owners to participate in habitat restoration *e.g.* entrance to the higher tiers of agri-environment schemes. However, most of these data were provided by FRCA either centrally or through nominated Countryside Stewardship Project Officers.

6.2 Response

Despite considerable efforts to standardise the data-gathering, there was great variation in the material submitted, the detail contained, and the speed with which different offices were able to respond. Appendix 2B identifies those offices which responded in time to be incorporated within this research contract. Further responses sent to the ITE will be collated and forwarded to EN Headquarters.

There was great variation in the nature of the schemes identified by the survey. In some instances, individual parcels of land were distinguished where schemes were already under way, and where full details of the area involved, engineering installed *etc* could be provided.

In other cases, especially where extensive habitat restoration schemes are as yet only at a very preliminary planning stage, little detail could be provided. Such large-scale schemes must be regarded as both speculative and highly confidential at this stage, requiring very full consultation with local landowners and institutions before they can be fully incorporated within the data-base assembled for the present research. The output of the survey comprises three elements:

1. completed questionnaires;
2. supplementary information (tables, maps etc.) submitted with the questionnaires; and
3. transcripts of interviews with EN offices made through meetings and by telephone.

These data are held in cross-referenced paper files at ITE Monks Wood, and full copies have been provided to EN Headquarters. These files are confidential to the ITE authors of this project, the offices that provided the data, and the EN nominated officers.

6.3 Integration with GIS

6.3.1 Approach and presentation of results

As described above, the main use of the data-base assembled through the survey was a summary table of spatially-referenced material for inclusion in the *Grazing Marsh GIS*. This table allowed the schemes (both extant and planned) to be readily cross-referenced against the lowland wet grassland blocks mapped by Dargie, and national biological data-sets. The accompanying Annexe provides an outline summary of these data – the full data-base having the same confidentiality as the paper-files from which it is derived. The material included in the Annexe for each scheme includes its location (exact where possible), its area, likely time-scale and type of scheme, together with special features and requirements, the source of the information and its confidentiality. A full explanatory legend precedes the Annexe itself, and is reproduced here as part of Appendix 2 (C).

For the purposes of the research, these survey data were linked to the *Grazing Marsh GIS* as point data with associated summary attributes. However, to ensure confidentiality, the data-set is security-protected, and only those individuals granted access to the paper copies of the file may have access to this GIS data-table (see 7.3). Original national grid references, that defined the south-west corner of 1km or 0.1km square, were moved to the central 1m square. The use of grid references allowed all schemes to be referred to an English Nature Natural Area. It was therefore possible to summarise the schemes within each Natural Area in terms of:

- **Project Type** *i.e.* creation, rehabilitation or enhancement
- **Total Area of schemes** *i.e.* summation of the areas (in hectares) for each project type.

The results of this summarisation are presented in Table 2, together with a synopsis of other restoration projects identified in each Natural Area, but where no detailed information is available on their extent. Where the extent of a planned scheme was provided in general terms (*e.g.* 400-500 ha), a mean value was used to calculate the overall area of each project type in

the Natural Area. From Table 2, it would be possible to infer that the current and planned total areas for grazing marsh restoration schemes are: 1) *ca.* 4645 ha. of creation and re-creation; 2) *ca.* 7215 ha. of rehabilitation; and 3) *ca.* 9000 ha. of enhancement. However, these figures include a number of major projects which are as yet little more than concepts, with no assurance that co-operation with relevant land-owners and other institutions will be possible, and hence no guarantee that the scheme can be realised. In addition, there are a very few instances of “dual-accounting” where a scheme may eventually be either rehabilitation or enhancement or some combination of these project types (*e.g.* South Downs).

6.3.2 Take-up of Countryside Stewardship Schemes

Appendix 3 provides a listing for each of 95 English Natural Areas of the proportional take-up of those Countryside Stewardship (CS) schemes which might contribute toward the restoration of grazing marsh. The main part of the Appendix comprises:

- Total size of the Natural Area in hectares (calculated from *Grazing Marsh GIS*).
- Total extent in hectares of grazing marsh within each Natural Area (derived from Dargie 1993, 1995; also calculated using the *Grazing Marsh GIS*).
- Take-up of the different CS options expressed (for each option) as a proportion of the national take-up for that option. Information is presented for:
 1. Field Boundaries
 - a. ditches; b) hedges; and c) mixed boundary types
 2. Old Meadows and Pasture
 3. Waterside Land
- Total take-up for all relevant schemes, expressed as a proportion of the national take-up.

Part 2 of the Appendix summarises these data by FRCA regions (East Midlands, West Midlands, South-west, North-east, North-west, South-east and South) and gives the actual total number of schemes taken up under each option nationally.

From these data, it may be deduced that very little restoration of surface drainage channels has been achieved as part of Countryside Stewardship. Rather attention has been paid to the hedgerow scheme – an activity which is widespread across most Natural Areas, but which does not advance restoration of grazing marsh landscape. The main contribution of Countryside Stewardship toward realising the goals of the cHAP for grazing marsh takes place under the “waterside land” option, and to a somewhat lesser extent, the “old meadows and pasture option” with English national totals of 1344 and 759 schemes respectively.

If these results are compared with the rankings for Natural Areas discussed above (section 5.4.4), it can be seen that relatively little Stewardship activity is taking place in those Natural Areas identified as providing the greatest likelihood of success. However, amongst those Natural Areas where the greatest relative gains in biodiversity might be realised, schemes

under both meadow and waterside options are widespread *e.g.* Lancashire Plain, London Basin, Mosses and Meres, Severn and Avon Vales, Solway Basin, Thames and Avon Vales, and Trent Valley and Rises. Thus Stewardship is likely to contribute most in badly degraded grazing marsh, producing gains in the distribution of less-exacting wetland species. Estimation of the area (in hectares) of such schemes is not possible from these data, and an assessment of progress toward BAP targets must rely on the results of the ITE survey, omitting this information.

6.3.3 Refining the targeting of grazing marsh restoration

An assessment was made of the current and planned activity toward grazing marsh restoration in those Natural Areas already identified as likely to provide a) the greatest likelihood of success (“core” – see 5.4.2), or b) the greatest relative gains in biodiversity (degraded areas). It must again be stressed that some of the schemes (particularly the largest ones) included in the ITE survey represent at present the long-term hopes of local officers, and it cannot be assumed that these potential schemes will indeed be realised, either in full or even partially.

Within “core” grazing marsh areas, where restoration may be expected to succeed, there are existing or proposed schemes to create (or re-create) *ca.* 1420 ha of grazing marsh, of which some 35% of the activity is planned for the Fens. Only 687 ha of re-creation is either taking place or (in most cases) envisaged in those Natural Areas where grazing marsh is restricted or degraded – nearly half this figure is accounted for by Trent Valley and Rises.

Appraisal of rehabilitation projects also shows that activity is dominated by a few proposed schemes in one or two Natural Areas. Hence though *ca.* 2125 ha of projects are under way or planned in the “core” blocks of extant grazing marsh, >80% of this area is contributed by the Greater Thames Estuary Natural Area alone. Similarly within Natural Areas with generally low quality grazing marsh, the total area of rehabilitation visualised is *ca.* 2225 ha, but nearly half of this total is accounted for by conjectural plans in the Humberhead Levels.

The 2050 ha of activity listed for the South Downs Natural Area may eventually comprise elements of creation, rehabilitation and enhancement, and is omitted from the above estimates of scheme total areas. These plans for the Arun and Ouse Valleys represent long-term speculation as to potential activity, rather than any imminently deliverable projects.

Of the 2595 ha (4645 ha if the generalised South Downs figure is included) of creation/re-creation activity documented by the ITE survey, only 725 ha is either in progress, at an advanced stage of planning, or more long term (but very likely to be realised). There are also 4 projects within this time-scale for which no area estimation is available (Table 2 Part 2). The remaining 1870 ha (3920 ha with South Downs) represent long-term proposals where at very most feasibility studies may have been initiated. Thus the re-creation area which may reasonably be expected to be realised represents <30% of the goal set by the cHAP, leaving *ca.* 1770 ha of re-created grazing marsh still to be delivered.

Similarly, of the 5165 ha (7215 ha with South Downs) of grazing marsh rehabilitation activity documented by the ITE survey, only some 2680 ha (and 8 other projects with no information on extent) can reasonably be expected to take place in the short to medium term. 2485 ha (4535 ha including the South Downs) remains at the stage of long-term contemplated activity. Even including such possible projects, the total area falls short of the 10000 ha identified by the cHAP as an objective. There is a clear need to identify a further 5000-7500 ha of

degraded grazing marsh suitable for rehabilitation which is not the subject of current or imminent rehabilitation projects.

6.3.4 The contribution of Environmentally Sensitive Areas to Grazing Marsh Restoration

According to the cHAP, some 50% of the area targets for restoration and re-creation should be contributed through the Ministry of Agriculture's Environmentally Sensitive Area (ESA) schemes. Table 6.1 lists those ESAs with significant areas of grazing marsh, the Natural Area(s) which contain each ESA and the overall biological ranking (section 5.4.1) given to the appropriate Natural Area. It will be observed that those ESAs where grazing marsh is the predominant landscape type correspond to Natural Areas which were amongst those most highly ranked in terms of biological quality scores *i.e.* The Broads, New Forest, Suffolk Coast and Heaths, South Downs, North Norfolk, the Greater Thames Estuary and the Somerset Levels and Moors. These are the key ESAs which would be expected to realise the 50% contribution toward the cHAP targets (see Table 6.1 below).

Those survey data included in the confidential Annexe (and summarised in Table 2) were further classified in terms of whether the schemes occurred within or without the boundaries of an ESA (Table 3). If the grand totals under each scheme type (recreation, restoration/rehabilitation and improvement/enhancement) are examined, it will be seen that the effort (ongoing and planned) within ESAs exceeds that going on outside ESAs in all cases, in improvement/enhancement schemes markedly so. It must be borne in mind that these totals include considerable activity which is "suggested" only, with no guarantee that it can be accomplished.

Table 6.1 Relationship between ESAs and EN Natural Areas, together with overall quality ranking of grazing marsh based upon six biological attributes

Environmentally Sensitive Area	EN Natural Area	Overall Biological ranking
Avon Valley	New Forest	2
	South Wessex Downs	51
	Dorset Heaths	11
Breckland	Breckland	27
Broads	The Broads	1
	East Anglian Plain	38
	North Norfolk	7
Essex Coast	Greater Thames Estuary	9
Lake District	Cumbria Fells and Dales	14
	West Cumbria Coastal Plain	20
North Kent Marshes	Greater Thames Estuary	9
Somerset Levels and Moors	Somerset Levels and Moors	13
South Downs	South Downs	6
Suffolk River Valleys	East Anglian Plain	38
	Suffolk Coast and Heaths	3
Upper Thames Tributaries	Cotswolds	67
	Thames and Avon Vales	27

However activity in ESAs does indeed account for at least 50% of current and planned activity, and may eventually be expected to contribute the 50% toward cHAP targets that is envisaged.

6.4 Review of ongoing and possible restoration effort

It is valuable to take note of some of the issues and problems which emerged from the survey of schemes described above, in Appendix 2 and the accompanying confidential Annexe. Such factors should be born in mind particularly when reading the conclusions of the study (section 7.3).

- Re-creation or rehabilitation is no substitute for **protection of existing high-grade sites**.
- However, there are huge benefits to be gained from more **effective management of existing degraded** and apparently poor marsh, as well as creation of **new marsh in largely arable areas** to link extant blocks and work toward providing a national network of grazing marsh sites.
- **The nature of the scheme was influenced by the Natural Area** *e.g.* creation projects predominate in the largely arable Fens, whilst most schemes in the Somerset Levels and Moors are rehabilitative in nature.
- **Restoration of a functioning floodplain and a drainage channel network** which could deliver high water-levels (with control structures) were common pre-requisites for successful schemes, yet it was acknowledged that there was increasing pressure on available water resources within the flatlands.
- The **quality of water** available for restoration was often poor, and control of nutrient inputs was a frequently listed requirement.
- There is some **potential conflict between differing restoration and conservation programmes**, including those targeted on different habitat elements within the whole BAP. Thus some restoration of grazing marsh might be at the expense of land reverting to reed-bed and tall-herb fen. Similarly, managed retreat of sea-defences might convert some arable land to marsh, but much of this might be salt-marsh rather than true grazing marsh. There is a clear need to balance and integrate the differing restoration demands and targets.
- Existing and planned effort to meet the **rehabilitation target** of 10,000ha was made up of many individual schemes, each of which was quite small in extent, though some long-term (or speculative) schemes in the Suffolk Coast and Heaths, Mosses and Meres and Severn and Avon Vales Natural Areas might make a significant contribution to achieving the required increase.
- Corresponding effort to meet the **re-creation target** of 2,500ha included a few very ambitious long-term schemes, which would considerably exceed this target were all to be successful. These schemes are situated in the Fens, Vale of Pickering and the Severn and Avon Vales.

7. Discussion

7.1 Review of ecological restoration schemes

As part of this project, a workshop was held on 7th December 1998 at Monks Wood for ITE staff with experience both in identification of targets for habitat restoration and evaluation of the likely success of restoration schemes. This section comprises a brief summary of the main points to emerge from the workshop. A full account of the discussions is included within the present report as Appendix 4.

7.1.1 Setting objectives

- The ultimate goal of ecological restoration is a functioning ecosystem closely related to the target semi-natural habitat.
- The pragmatic objective of ecological restoration is to achieve the presence of indicator species and appropriate communities.
- Selection of objectives should be on the basis of both attributes and species: such attributes and species should be classified as:
 - i. Core
 - ii. Desirable
 - iii. Neutral
 - iv. Negative
- In grazing marsh restoration, types of objectives should include:
 - i. landscape;
 - ii. physical;
 - iii. biological
 - iv. socio-economic; and
 - v. historical factors.

7.1.2 Measuring success

- Evaluation of restoration schemes is essential to:
 - assess effectiveness;
 - measure progress;
 - allow adjustment of goals; and
 - inform future schemes.
- In practice, several simple measures can be applied to measure success *i.e.*
 - indicator species and species associations;
 - similarity to target community;
 - environmental and biotic indices; and
 - Compliance.

- Restoration success of individual schemes needs to be put in a wider context, through long-term monitoring of semi-natural and restored habitats.

7.2 Identification of land for grazing marsh restoration

7.2.1 Progress toward project objectives

Three kinds of information were required for the successful completion of the research:

- GIS data-sets on distribution of biota, site quality and extent, and designated land;
- inventory of schemes (in progress and planned) which might meet cHAP targets and
- assessment of the practicality of grazing marsh restoration based on hydrological and land-use criteria (liability to flood, altitude, land-cover *etc*).

At the end of the present contract, all parts of this process had been completed essentially successfully, though gaps remained in the inventory of schemes. Completion of the latter data-gathering exercise was limited by:

1. Records of schemes being held by diverse bodies in a wide variety of formats.
2. Not all schemes being documented.
3. Absence of a comprehensive list of sites with designation lower than SSSI *e.g.* Sites Interest for Nature Conservation (SINCs) which contain lowland wet grassland
4. Dependence on resources being available in each office contacted to provide such information.
5. For statutory bodies covering agri-environment schemes, access was granted to only a few offices, with very restricted detail on the location and extent of schemes (see below).
6. Difficulty in allocating schemes to particular categories *i.e.* 1) Creation and/or re-creation; 2) Restoration and/or rehabilitation; and 3) Improvement and/or enhancement.
7. Most importantly, the inclusion within the survey of schemes with a huge range of time-scales and probability of completion.

In the particular case of agri-environment schemes (point 5 above), it is acknowledged that a contract of confidentiality exists between MAFF and the farmer/landowner in receipt of CSS/ESA grand-aid. Consequently, identification of individual schemes may not always be possible, and summaries at a Natural Area or ESA scale may have to suffice. Areas most likely to deliver national targets for rehabilitation and re-creation of grazing marsh (7.2.4) must be regarded as preliminary. Partly due to this lack of detailed information on extant and planned schemes, it is difficult to precisely estimate what progress has already been made toward meeting cHAP targets, and hence where exactly further effort should be focused and

on what scale that effort is required. It is clear that further data on schemes should be collected to enable the targets set in the present report to be refined.

7.2.2 Refinement of targeting using flood, altitude and land-cover data

Following discussion between EN and ITE, it was decided to include data in the *Grazing Marsh GIS* on the area liable to flood in each Natural Area, and to link this data-set with a) the Dargie polygons that define the lowland wet grassland resource and b) the distribution of arable land below 5m AOD where re-creation of grazing marsh may be practical. These data-sets were provided by FRCA and IH in February 1999 and integrated with the ITE *Land Cover Map* within the *Grazing Marsh GIS*.

Methodology

The following summary describes the methods used to identify areas of land with the potential for wet grassland recreation or rehabilitation. Using the data-base of the *Land Cover Map* (LCM), the analysis firstly identified 25m cells of England (on the Great Britain National Grid) satisfying the following criteria:

- below 5m AOD contour and/or liable to river flooding; together with
- in one of five *Land Cover Map* classes: **6**: Mown/grazed turf; **7**: Meadow/ verge/ semi-natural; **8**: Rough/marsh grass; **18**: Tilled land; and **19**: Ruderal weed

Each cell was also classified as to whether it was inside or outside a Dargie polygon.

The **Input** data-sets used to specify the ‘potential wet grassland’ criteria were:

Data-set description	Type	Origin	Criterion
<i>Land Cover Map</i> of Great Britain	25m grid	ITE	Membership of <i>LCM</i> land classes 6, 7, 8, 18 and/or 19
Areas liable to river flooding	25m grid	IH	Within an area liable to river flooding
5m AOD contours	Polygon	FRCA	Below 5m
Dargie site boundaries	Polygon	EN	Inside/outside Dargie site
Natural Area boundaries	Polygon	EN	Natural Area membership

The **Outputs** were an *Arc/info* grid of England and an Excel spreadsheet of total low-lying/flood-liable areas in each Natural Area.

- a) “*Flood*”: *Arc/info* grid (25m resolution) showing cells that satisfied the criteria for potential wet grassland. The attributes of this grid were:

Value: Unique for each *LCM*/Dargie presence/Nat. Area combination (primary key)

Count: Number of 25m cells in Value

Na_g: EN Natural Area number

Lcm_class: *LCM* class (**6,7,8,18** or **19**)

Dargie: Location relative to Dargie site (INSIDE or OUTSIDE)