ENGLAND

The Pevensey Levels Wetland

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THE CONTEXT

Introduction

The Pevensey Levels face many of the challenges confronting the management of wetlands throughout the world. The numerous land owners have a variety of objectives for utilising the wetlands and there are overlaps and gaps in the responsibilities of the various agencies involved. The Levels were a candidate Ramsar site until 1990, but have suffered degradation in recent years due to drainage improvement and agricultural intensification. This case study provides an outstanding example of how the various stakeholders have been involved in the decision-making process, which will hopefully lead to a more sustainable management and wise use of the wetland.

Of particular importance has been the establishment of a Study Group of local stakeholders, whose role has changed since its establishment in 1992 from identification of the issues facing the Levels to problems of implementing the Wildlife Enhancement Scheme which compensates landowners for environmentally sensitive land use. More recently the Group has played a central role in the development of a water level management plan for the Levels and in controlling an invasive exotic plant.

The setting

The Pevensey Levels are a wetland of international importance lying between Eastbourne and Bexhill-on-Sea, East Sussex, England (Figure 1), the formation of which was dominated by the changing relationship between land and sea. They are classified in the UK as wet grassland (RSPB et al, 1997) and were originally seasonally flooded (Ramsar inland wetland type 9). The wetland catchment is delimited by the foothills of the Weald to the North, composed mainly of Tunbridge Wells Sands, and outcrops of Wadhurst and Weald Clays to the east and west. The southern boundary is formed by the Crumbles shingle ridge which isolates the wetland from the sea and is a relict geomorphological feature of early Holocene origin.

The Levels themselves are a complex inter-bedded sequence of alluvial clays and peat. The peat layer is of variable thickness and fragmented in nature. It is generally overlain by at least one and a half metres of clay. The soils developed upon these substrates are described as *'deep stoneless, mainly calcareous clayey soils of the Newchurch series of the Wallasea sub-group'* (British Geological Survey, 1987).

Hydrology of the Pevensey Levels

The hydrology is dominated by the dynamics of the relationship between stream inflow, rainfall, outflow to the sea and evapotranspiration. Groundwater movement is not important, since a clay layer effectively isolates the Levels from the underlying chalk aquifer. Meteorological data collected at the Horseeye Meteorological Station suggest that the mean annual rainfall (between 1941-1970) was 800mm (Southern Water Authority, 1971a). Comparisons with the 1961-1990 mean annual rainfall value has suggested a 5 % increase in recent years (National Rivers Authority, 1993), although several droughts in the past 25 years have been significant. There is an eastwards decrease in rainfall; prevailing south-westerly winds loose a considerable proportion of rainfall when passing over the South Downs, 15 kilometres due west of the wetland. Annual evapotranspiration calculated by the Penman method (1941-1970) estimate values of 550 mm/yr on the seaward side of the wetland and 525mm elsewhere on the wetland assuming a surface albedo of 0.25 (Southern Water Authority, 1971b).

The Wallers Haven is the principle source of surface flow to the wetland water budget, draining 600 ha of upland catchment in addition to 320 ha of grazing marsh. In contrast to the Pevensey Levels, the upland area is characterised by sharp relief and deep valleys. In addition, seven Sewage Treatment Works (STWs) discharge into the Pevensey Levels. Water from these sources can account for large proportions of inputs to the wetland water budget, particularly during dry summers. Contributions from these sources are an import to the hydrological system, water having originated in the Arlington Reservoir, in the catchment of the Cuckmere River, directly to the West of the Pevensey Levels.

History of the Pevensey Levels wetland

The earliest records describing the Pevensey Levels date from Roman Times. At that time, all land below 4 m O.D. was submerged at high tide and the area was a wide, tidally-influenced bay studded with an archipelago of small islands or *eyots.* These areas have retained these names to the present day (eg. Horseeye, Chilley). The Roman garrison fort of Anderida was sited in a peninsula jutting out into the bay and it was here that William the Conqueror landed in 1066.

The main feature that characterises the history of the wetland to the present day, has been the continuing effort of local peoples to utilise and exploit the marsh. There is evidence to suggest that salt making was an important occupation in the area at the initial stages of the economic exploitation of the marsh. Attempts to reclaim the marsh date as early as 772. Evidence from two Anglo-Saxon charters of the time and records from the castle *demesne* suggest that the land was ploughed, sown and harvested at this time, albeit on a small scale. Indeed, 300 years later, the Domesday Book (1086) reveals that salt water still inundated much of the present marsh area.

Reclamation in earnest began in the Middle Ages and was achieved by progressively enclosing portions of the marsh within sea walls. The main factor that allowed the reclamation of the Pevensey levels was undoubtedly the development of the Crumbles shingle ridge. In the latter part of the last glaciation large amounts of sediment were transported and deposited on the bed of the English Channel by Sussex rivers. Rising sea levels from about 10,000 years BP facilitated the large scale remobilisation of these

sediments and a dissipative wave regime encouraged major episodes of coastal progradation. This resulted in the formation of a highly mobile shingle ridge. The Crumbles, which effectively blocked the tidally-influenced bay from the sea, but created problems of localised fresh water flooding.

The onset of these conditions encouraged the large-scale reclamation of the wetland. From the first '*inning'* to the end of the 14th century all the Levels drained out to sea to a point due south of the castle. In the latter part of the 14th century a large cut was made to replace the former outlet. Another cut was made due west, diverting the Ashbourne stream to provide more effective water evacuation and groynes were built into the shingle ridge to stabilise it. Ditches were constructed to connect with these main channels and by 1696 the *'innings of the Pevensey Levels'* had been completed.

Land Use and Management of the Pevensey Levels wetland

Apart from the continuous struggle to keep the frontage of the Levels in good condition, the area at the beginning of the 20th century was very much the same as at the end of the 17th century. Indeed the 1942 land utilisation survey of Briault and Henderson reports that in 1938, the Levels were still entirely under permanent grass, grazed in summer for the fattening of barren cows and bullocks. The marsh, however, was still prone to flooding in the winter, and this was an integral and necessary part of the management of the area for grazing. The 1930 Land Drainage Act provided a new impetus for drainage, offering funds for the establishment of local Drainage Boards (a committee of farmers) to address the problems of fresh water flooding. The Boards widened outfalls of the main channels and fortified flood embankments.

Between 1959 and 1977 eight individual pumped-drainage schemes were approved as part of the national post-war drive towards agricultural self-sufficiency. These schemes divided the marsh into eight distinct hydrological units; the general design principle of these schemes was that excess flood waters in lowland ditches were conveyed to a main low-level channel leading to a pumping station. Water was then pumped into high level, embanked channels leading to marine outfalls at either Pevensey or Norman's Bay. Drainage costs of about £1500 per 100 hectares were rapidly recouped by landowners thanks to a 50 % grant from the Ministry for Agriculture, Fisheries and Food (MAFF).

These drainage improvements allowed the extension of the grazing season and the proliferation of arable farming in the area. Between 1968-1975 some 5 % of the marsh went into arable cultivation. The completion of drainage schemes in the late 1970s, coupled with increasing grants available from the European Community's Common Agricultural Policy, led to the extension of arable practices to close to 20 % of the total wetland area by 1990.

Part of levels are own by English Nature (the government's conservation agency) which designated parts of Levels as Sites of Special Scientific Interest (SSSI) and National Nature Reserves in 1977. In recent years the Sussex Wildlife Trust has purchased land on the Levels and are managing it specifically for nature conservation. The Trust leases land to farmers for low intensity grazing and has excavated hollows (scapes) in some fields to encourage localised winter flooding. In general, the conservation bodies have promoted high water levels in winter to attract wildlife, whilst the farmers require low water levels to prevent inundation and water logging of agricultural land. These different water level objectives have

created conflict between farmers and conservation bodies, although some generic compromise water level regimes have been suggested (Figure 2).

Human-Environment Relationship

The long history of human intervention with the local wetland environment have created a series of wetlands in a continuum between the natural state and intensively farmed land. Such wetlands are termed *'wet grasslands'* in the UK (RSPB *et al*, 1997), although the terminology differs significantly in different quarters. This type of marshland represents a historic landscape of great importance, both for its value in supporting agriculture, and in terms of its intrinsic value as a habitat of botanical and faunal interest (Cook and Moorby, 1993).

Reclamation has produced a network of terrestrial and semi-aquatic habitats including pasture meadows and wet meadows intersected by a network of drainage ditches. The ditches are particularly rich in botanical terms; the Pevensey Levels exhibit a hydroseral sequence without equal in the UK and 110 of the 160 plants classed as aquatic in the British Isles have been recorded on the wetland.

The wetland is similarly important in faunal terms. The Levels are the most important site in England for freshwater molluscs, indicators of clean, still calcareous water (Killeen, 1994), and include four nationally rare species *Valvata macrostoma, Segmentina nitida, Anisus vorticulus* and *Pisidium pseudosphaerium.* Some 120 species of insect and 21 species of dragonfly, including the nationally scarce dragonflies *Brachytron pratense* and *Coengrion pulchellum*, have been recorded and the wetland is the only site in the country for 2 species of aquatic beetle (*Bidessus unistratus, Laccophilus varigatus*). Probably most importantly however, the Levels possess the only expanding population of just two British colonies of *Dolomedes plantarius*, Britain's largest spider.

With regard to birdlife, the Pevensey Levels are an important habitat for *Vanellus vanellus, Gallinago gallinago, Tringa totanus, Pluvialis apricaria* and *Motacilla flava flaviisima* populations. In the past numbers of *Vanellus vanellus* and *Gallinago gallinago* have regularly exceeded 1 % of the British population, qualifying the wetland as a candidate Ramsar site, although there is considerable debate over the national numbers of the latter species (Hitchings, 1987).

The site was a candidate Ramsar site until 1990. The national decline of characteristic avian species of wet grasslands are well documented and the Pevensey Levels provide a vivid example of the effects of drainage improvement and agricultural intensification on wetland species diversity (see for example Green and Robins, 1992). Pump drainage schemes have been instrumental in reducing the extent and duration of flooding and lowering the water table. Winter flood waters are pumped off the lowland and discharged to sea in accordance with the tidal cycle. Some localised flooding does still occur since the outfalls are tide-locked for half of every day, but the channels into which the pumps discharge water are engineered to provide sufficient water storage during these periods. The result has been a general reduction in over-wintering and breeding bird numbers since 1970. In the case of *Vanellus vanellus* this has been attributed to the intensification of grazing practices leading to disturbance and nest trampling. *Gallinago gallinago* are more susceptible to the drying out of

soils and the lowering of the water table and cannot probe in ground where the water table is more than 20 cm below the surface (Royal Society for the Protection of Birds, 1997).

Hydrological management on the wetland

The historical legacy left by centuries of drainage and alteration has left a highly complex hydrological system, the functioning of which is heavily determined by those individuals of the local population involved in farming the land. Ditch water control and management is a crucial aspect of successful farming in these areas and some form of water control structure, sluices, bunds or penning boards is present on most ditches. This means that ditch water level can be engineered to suit the requirements of adjacent fields. These are managed by the Internal Drainage Board (IDB) which in the case of Pevensey is run by the Environment Agency. The IDB employs two sluice keepers that liaise on a daily basis with land owners and flood defence officials to engineer the correct water level management in each of the pumped units of the wetland. This is a complex operation since there are over 700 km of ditches on the wetland (Lindsey, 1992) and over 200 water control structures (Douglas and Griffiths, 1995). The increasingly 'engineered' fluctuations of ditch levels that have resulted have been blamed for the loss of some of the wetland's botanical and faunal interest.

The general management principle of ditch water levels is to retain low levels in the winter to provide sufficient capacity to store flood water. At a larger scale, levels in the two main embanked drainage channels dissecting the wetland, the Wallers Haven and Pevensey Haven, can be regulated by automatic, top-opening water retention gates some 500 metres from each of the main outfalls. In this way water can be retained in the summer or during periods of tidelock. Since all ditches in each of the pump drainage units are inter-connected, during the summer water can be fed into the lowland through gravity gates at each of the pumping stations to irrigate crops, provide drinking water for cattle and create the effective partitioning of fields by *'wet fences'*.

Water for public supply is directly abstracted from the Wallers Haven at Hazards Green. Southern Water are licensed to abstract a proportion of the daily flow. This can, in dry summers, represent up to 10 % of the total flow of the river (NRA, 1993) but the water level must not fall below 1.75 m O.D, the Minimum Residual Flow (MRF). When water levels reach this threshold, abstraction may only take place if the river flow is augmented upstream by the water company. This is achieved by operating a series of pumped ground water boreholes in the headwaters of the upland streams feeding the Wallers Haven. Located upstream of the stream gauging stations augmentation during drought can be monitored and regulated.

Designations of the Pevensey Levels wetland

The wetland has been a Site of Special Scientific Interest since 1977 on the basis of its faunal and floristic richness under the National Parks and Access to the Countryside Act (1949). This form of environmental protection was furthered under section 28 of the Wildlife and Countryside Act (1981) resulting in the re-notification of the site by 1990. The wetland was up until this time a candidate Ramsar site and Special Protection Area under the European Communities (now European Union) Directive on the Conservation of Wild Birds (79/409/EEC). However, surveys of over-wintering numbers of *Vanellus vanellus* during the 1990s have indicated a significant decline in numbers and the site no longer qualifies.

The rate and scale of damage to SSSIs throughout the country suggests that the standard of protection afforded by this system is inadequate (Fojt, 1992). Most of the criticism has revolved around the lack of statutory measures to control development within designated areas. SSSI designation provides the wetland manager with only *'a breathing space within which to apply moral pressure with a view to persuading the owner to make a voluntary agreement'* Lord Mustill in RSPB, 1994), where a proposed development scheme is considered to be harmful to the local environment. Although the scheme does involve considerable detailed biological investigations prior to designation, other problems have hinged around the non-integrated approach instilled. The notification of the Pevensey Levels protected only land below 5 m OD, reneging a catchment-wide protection.

This has posed considerable problems in terms of development on the boundaries of the SSSI. The main STWs at Hailsham North and Hailsham South lie beyond the SSSI boundary, making it more difficult to regulate discharges from these. The nutrient status of waters discharged onto the wetland by STWs has been cause for concern in recent times. Studies by the National Rivers Authority (now the Environment Agency), have shown that nutrient enrichment may be an important process on a number of major channels of the wetland and that the area of influence of the Works are extensive (Jennings, 1994). These concerns are visible in the field; numerous ditches close to the main STWs have dense algal carpets covering them. In an attempt to address these problems, the Agency has approached the Department of the Environment to designate it a sensitive area for water quality.

Schemes for the restoration of the Pevensey Levels wetland

Changing societal attitudes to environmental issues coupled to recent changes in rural land use policies have provided the opportunities and economic means to address the degradation of wetland ecosystems (Pyewell *et al.*, 1994). Numerous schemes which aim to encourage a more traditional approach to farming are applied on many wetlands. All offer some form of financial compensation to the land owner. At the top of this financial scale lie the Environmentally Sensitive Area schemes. Section 14 and Countryside Stewardship Schemes offer smaller payments for the maintenance of a traditional *landscape*, as opposed to the environmental value of an area instilled by larger schemes.

The Pevensey Levels became a 'pilot' site for the Wildlife Enhancement Scheme (WES) in November 1991. This scheme is a *voluntary* agreement between English Nature and individual landowners, offering payments of £74 ha/yr for specific beneficial management operations. Prescriptions are shown in Box 1. Payments are provided twice a year in arrears. Agreements run initially for a three year period, after which they are renewed for a further three. This also gives the landowner the option to leave the Scheme if appropriate. In the first year of the Scheme some 60 Pevensey Levels owner/occupiers joined, covering 1550 ha, well over half the SSSI area. In 1995 the pilot status was ended and funding by the Department of the Environment was agreed until 1998.

Box 1 Prescriptions for the Pevensey Levels Wildlife Enhancement Scheme

A sum of £30 per acre per year is paid in arrears to landowners who are encouraged to:

- carry out a rotational approach to ditch cleaning
- dispose of dredgings at least 5 metres from the ditch to prevent renutrification via run-off
- maintain ditch water levels as constant as possible at no more than 300 mm below ground level between March and September and no more than 600 mm below ground level between October and February, subject to a minimum ditch water depth of 300 mm
- refrain from the use of fertilisers, herbicides and pesticides (unless specific application have been previously agreed with English Nature)
- graze only at low stocking rates before July in order to avoid nest trampling
- maintain permanent pasture and the old marsh contours
- keep a record of what management has been carried out
- mow for hay or silage only from July and carry out any topping of thistles or nettles only in July and August

WES is a success in conceptual terms, since it seeks to unite the requirements of two traditionally conflicting points of view in water level management terms; it encourages higher ditch water levels but does not openly advocate the use of surface flooding as a management tool, tool which is often described as 'unmanageable' by the farming community. However, the lack of this prescription is the main criticism of the scheme by the conservationist lobby and it has been suggested that following the next round of agreements a surface flooding 'tier', with added compensation, may become part of the scheme in 1998.

In recent times the management of ditch water levels in wet grassland areas has come under increasing scrutiny, a factor of the increasing difficulties in uniting the ditch water level requirements of different stakeholders on opposite banks of the same ditch. Water Level Management Plans (WLMPs) have become a statutory obligation in many wetland sites across the UK. Regulated under the auspices of the Ministry of Agriculture, Fisheries and Food, but drawn up by the respective Internal Drainage Board, the plans provide a means by which the water level requirements for a range of activities including agriculture, flood defence and conservation can be balanced and integrated. However, in the case of the Pevensey levels this has not been an easy task. The water level requirements of the grazier, the arable farmer and local wildlife are markedly different, particularly in terms of the annual cycle of level fluctuations.

THE PEVENSEY LEVELS STUDY GROUP

History

In July 1992 the National Rivers Authority hosted a seminar on the Pevensey Levels. Conservation bodies had for some time feared the site was deteriorating to the extent that its designations were under threat. It was agreed that a Study Group be set up to address the issues raised at the seminar. The Study Group first convened in October 1992 and has met

regularly since its inception. Meetings are held every four months, where possible, although two meetings a year have been the norm unless extraordinary circumstances arise.

Objectives

The Terms of Reference of the Group are given in Box 2. It does not provide a statutory mechanism for decision making and attendance is voluntary. The Environment Agency acts as the Internal Drainage Board in the Levels, and is thus the primary coordinating body. In terms of flood defence and agriculture, it must ensure that requirements are met, but it is also bound by *Conservation Guidelines for Drainage Authorities* (part of the Water Act of 1989) which states that "environmental issues must be considered alongside engineering and economic objectives at the earliest stages of planning" and that "consultation prevents misunderstandings and is vital at every step".

Box 2 Pevensey Levels Study Group - Terms of Reference

Objectives

To identify and address issues relating to and threatening the integrity of the Levels SSSI.

Operation of the Group

The Group will:

- exchange ideas, information and issues pertaining to the Pevensey Levels and will ensure that consultation takes place with appropriate organisations and individuals.
- ensure that monitoring on the Levels is co-ordinated so as to avoid duplication of effort. Where feasible and appropriate, results of monitoring will be communicated to the Group.
- serve to identify financial resource requirements and will advise on the most appropriate form of lobbying (eg. to MAFF)
- be responsible for coordinating the development of Water Level Management Plans and for their implementation

Frequency

The Group will generally meet on a bi-annual basis unless special need for further meetings arise.

Coordination

Meetings are chaired by the Environment Agency. Minutes of the meeting are circulated to all interested parties following each meeting and participants are normally given two weeks to respond. Agendas for each meeting are set by participants.

A strong proactive facilitator for the Group, with a clear vision of the Levels, with an enthusiastic support team has proved a vital requirement for the success of this approach to wetland management and decision-making and this role has, until recently, been played by Agency's Water Resources Manager for the Southern Region. The fact that a senior manger has taken this role is testimony of the importance of this approach to the Agency. Having access to all key stakeholders means that all relevant issues are raised at the Group meetings and can be taken into account when considering, approving or implementing a scheme, thus post-decision criticism can be minimised.

Membership

Current membership of the Study Group is given in Box 3.

Box 3 Pevensey Levels Study Group - Membership and roles

Environment Agency	Chairperson Conservation representative Flood defence representative Water resources representative Other functional specialists as required (eg fisheries)
English Nature	Statutory conservation agency responsible for SSSI designation, implementation of WES and management of National Nature Reserves
RSPB	Charitable conservation organisation with a historical interest in the site due to waterfowl and wader breeding and overwintering
Sussex Wildlife Trust	Local wildlife trust and professional interest in the safeguard of wetland sites in Sussex. Landowner on the Levels (National Nature Reserve)
National Farmers Union	Body representing the interests of members and agricultural communities.
Landowners and FWAG	As appropriate
Technical Advisors	University College London, Institute of Hydrology, others as required.

Membership is periodically reviewed and consideration has been given to other interest groups such as the Tourist industry and local community. A key feeling amongst the Group

has been that core membership should be those who have *responsibility* for managing the Levels in addition to an *interest* in them. Furthermore, if the size of the Group was expanded meetings would become less easy to manage. Wider stakeholders participation, which is a key philosophy of the Group, is achieved in two ways. First, any reports or recommendations from the Group are circulated to individual landowners and the Group has established close liaison with the local Area Environment Committee which includes membership of local Councils, Tourist Board, Ministry of Agriculture, Fisheries and Food and other interest groups.

Successes of the Group

Perhaps the most important benefit of the Group has been to provide a forum to raise, discuss and propose solutions to specific local concerns whether from the farming community or conservation interests. A simple example is the problem of access raised on numerous occasions by different members of the group. The main problem is that raising ditch water levels for environmental prescriptions has tended to result in the flooded gateways, particularly in the winter and early spring. Payments for one off re-engineering of gateways have provided by WES with "over"-engineering to prevent future problems.

Initially the Group discussed matters of a general nature. As time has passed however, discussion has tended to become more focused on firstly issues relating to the Wildlife Enhancement Scheme and secondly to those accruing from development of the Water Level Management Plan. In all these areas, the Group has provided a valuable and complementary tool in resolving stakeholder problems. In managing the WES for example, English Nature already has undoubtedly benefited by the wider scale approach provided by the Study Group. English Nature is used to dealing with individual signatories to its Scheme, but in the Group provides the opportunity to speak to the farming community as a whole through the National farmers Union representative who regularly attends meetings. Drafts of the Water Level Management Plan have been circulated to all landowners and Group members have been available to provide explanation where necessary. It has resulted in rapid development of the Plans which would not have been possible without the Group.

A particularly good example of the value of the Group has been provided by the coordinated response to the problem of infestation of the drainage channels by *Hydrocotyle ranunculoides*, the floating pennywort. This plant is a native of North America but was brought to Britain in the 1980s by the aquatic nursery trade to sell as a marginal plant. Under UK conditions mats of vegetation have been observed to grow up to eight metres from the bank in a single season, out-competing other vegetation. In ideal conditions it can double its biomass in three days (Klemm et al, 1993). The Study Group recognised the potential seriousness of this plant for the health of the aquatic ecosystem. Expert advice (Centre for Aquatic Plant Management) has recommended that long term control requires eradication using the herbicide 2,4-D Amine. The negative side-effects of this chemical on native vegetation can be significant and its use by any single organisation or individual would create a public outcry. However, the existence of the Group has facilitated preparation of a plan of action for careful use of the chemical (in collaboration with the Centre for Aquatic Plant Management). In addition, a public information campaign has been mounted explaining to the potential devastating consequences of not controlling the weed, which will be endorse by the Group as representatives of local stakeholders.

Problems for continued cooperation

Whilst the Group has played an important role in unexpected issues, such as the pennywort infestation, its future will be closely tied to specific activities such as implementation of the Wildlife Enhancement Scheme or development of Water Level Management Plans. Local farmers have made it clear that although they may be interested in conservation, they are first and foremost businessmen, with the farm as their business. Without a scheme to compensate farmers financially, they would not be able to agree to water levels which would affect their farming. Much depends on the situation of the landowner, for absentees who lease the land, £30 /acre/yr is an attractive subside, whereas it is insignificant for say an active sheep or beef farmer who can earn upwards of £1500/acre in a good year. English Nature has suggested that in 1998, when the current levels of funding are reviewed, a additional payment may be made to farmers who allow surface or "splash" flooding of land. The aim is to have 500 acres of land within this management tier, although the amount of funding available for such a scheme is not yet known.

Recent changes in the circumstances of farming have also played their part. Much of the wetland is devoted to grazing for the fattening of stock. Cows form the main stock on the Levels and losses in income have been substantial following the fall in the value of beef associated with the presence of Bovine Spongiform Encephlopathy (BSE) in British cattle and the possible transmission of this disease to humans in the form of Creutz-Feld Jacob Disease (CJD). To some extent this has been beneficial to the conservation community as farmers are keen to boost their incomes through other subsides such as the Wildlife Enhancement Scheme. This may change when the beef crisis is over.

SCIENCE TO UNDERPIN MANAGEMENT

A second key element in the management of the Pevensey Levels has been the commitment to funding scientific studies to underpin decision making. This has been very complementary to the stakeholder participation as Study Group members have frequently asked for best scientific opinion or information when faced with a decision to be used along side their personal experience and views.

Field Hydrology

To investigate the effects of WES prescriptions in the Levels, comparisons have been made of water table dynamics in areas managed with WES and areas where the prescriptions were not in place. This consisted of three ditch water level recorders and three transects of dipwells on the fields adjacent to the recorders. In this way, the relationship between ditch water levels and water table levels in the intervening land blocks could be studied in detail. The network was installed by the Agricultural Development Advisory Service (ADAS) and maintained by the Environment Agency.

Because of the low permeability of the soils high ditch water levels only have a significant impact on field water table levels close to the ditch. Thus the water level management persciptions in WES are not capable of achieving their hydrological and therefore ecological objectives. Saturated soils or near-surface water table levels in the centre of fields can only be achieved by inundation of the land or a very dense network of ditches or a ridge and

furrow systems. It is therefore likely that WES will need to be adapted to encourage surface flooding.

Wetland Hydrological functioning

The highly complex nature of the hydrological functioning of the site prompted the National Rivers Authority (now Environment Agency) to seek a scientific input into the management of a wetland. A tri-partite project was established involving the Agency, University College London and the Institute of Hydrology, with a view towards providing a detailed assessment and analysis of the hydrological functioning of the wetland. The project aims to provide a hydrological model of the wetlands to predict the outcome of various management scenarios.

Economic valuation of the wetland resource

The valuation of ecological goods is a subject which is recently the subject of considerable debate, not least because of the suitability of the methods employed. Increasingly environmental improvement schemes have to operate within the bounds of cost-benefit. This means that the benefits that accrue from a given scheme must ultimately justify the financial input to the scheme in the first place.

To assess the economic value of the Wildlife Enhancement Scheme, the University of Newcastle undertook a Contingent Valuation study to determine the public's *willingness to pay* for such a scheme. This is particularly important as the scheme is financed by the tax payer. Results produced benefit cost ratios comfortably in excess of unity, implying that the scheme provided good value for money for the local population. However, University College London has recently undertaken a further study which questions some of the findings. They re-interviewed many of the local people who had responded to the original questionnaires and found that they would have responded in a different way had they been better informed about the objectives of the study.

CONCLUSIONS

The fate of the Pevensey Levels will ultimately be decided by factors such as agricultural subsides, legislation and ability of conservation organisations to purchase and manage land. However, stakeholder participation is an essential mechanisms for agreeing management objectives which can be used to guide management tools, such as water level management plans or targeting of funds to compensate farmers for environmentally friendly practices.

Results

The Pevensey Levels Study Group provides an excellent example of an approach involving local stakeholders in the wetland management process. The key results have been:

1. breaking down of barriers and dispelling preconceived ideas about other stakeholders
2. exchange of information, debate and reaching consensus on a range of issues.
3. the evolution of the Group's role as the issues and problems facing the Levels have changed and clarified as various schemes and management initiatives have been implemented

4. the underpinning of debate and decision-making by sound science
5. making integrated management of the wetland a realistic goal
6. underlining contradictory nature of parallel management practices specifically nature conservation, agriculture and flood defence
7. providing a forum for implementing, monitoring and evaluating specific projects such as the Water Level Management Plans and Wildlife Enhancement Scheme
8. supporting fund raising for infrastructure (eg. sluice gates), scientific studies, time of Group participants
9. identifying new issues, eg. further monitoring and evaluation needed (eg. Wallers Haven flows, discharges to sea), higher incentives for farmers needed, additional staff (eg sluice keeper), integration of catchment including land above 5 m and land upstream of Levels
10. dealing with emergencies, such as the pennywort invasion.

RECOMMENDATIONS

1. All wet grasslands in the UK face similar problems to those in the Pevensey Levels. Indeed, these are characteristic of all reclaimed lands since agriculture has, historically tended to be the main driving force behind reclamation. Stakeholder participation is key element in effective management and the Pevensey Levels Study Group provides has provided a valuable forum for exchange of information, debate and consensus building. Where a wetland sustains two such distinctive groups with considerable objective differences, such a Group provides a mechanism capable of achieving the sustainable management of the wetland in both agricultural and conservation terms, through dialogue discussion and interaction.
2. The entire catchment must be considered in planning and management process. This will require involving stakeholders beyond the wetland itself.
3. Membership to the consultative Group should be voluntary, it should representative as many interest groups as possible, but a manageable size. Where there are large numbers of stakeholders, priority can be given to those who have *responsibility* in addition to *interest.* Good dissemination of information within the Group is important, with time to make comments and respond. Procedures for consulting interested parties outside the Group is required.
4. A strong, proactive Group facilitator is essential, who has local knowledge and a clear vision of wise use of the wetland, but who takes note of stakeholder views and has considerable powers of negotiation. Bodies seeking to attempt such a scheme should target suitable individuals as opposed to simply electing someone who is willing to do it. Group members must be treated equally, regardless of, for example, the area of land they own. However, a procedure for reaching consensus must be agreed to avoid stalemate when different views cannot be reconciled.
5. Clear Terms of Reference should be drawn up to ensure that there is no ambiguity as to the objectives of the Group. The bulk of activities of the Group should be targeted towards specific objectives, such as establishing a Water Level Management Plan or implementing a Wildlife Enhancement Scheme.
6. It must not be forgotten that current habitat value of such wetlands is purely and solely a result of a certain traditional forms of agriculture through historical time and not a “natural” system which must be protected from human interference.
7. A scheme for financial compensation must be established if stakeholders who earn a livelihood from practices which conflict with others, are to agree to changes.

8. The experience and views of the stakeholders is one element which underpins decision-making. This must be complemented by sound scientific results if wise decisions are to made about management of the wetland.

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FIGURES

1. Location map
2. Water level regimes (a) for arable farming (b) for wildlife conservation (c) compromise regime after Spoor and Gowing (1995).