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ARTICLE

Mitigation Banking: Securing No Net Loss to Biodiversity? A UK Perspective

WILLIAM LATIMER & DAVID HILL

Introduction

Environmental advisors and planners are frequently confronted with the issue of ecological mitigation for losses due to development, and especially the uncertainty over whether the proposals are adequate, whether the techniques employed will be successful and how any compensation habitats will function over time. Over the past two years we have been reviewing the potential role of early ecological design and management prior to the main phase of development planning. The advantages of acquiring additional land, perhaps primarily for ecological mitigation, was noted as a means of minimizing ecological risks during development and maximizing ecological, as well as longer-term financial, gains. In particular, the review focused on the situation where additional land of low habitat value could be acquired adjacent to, or in the neighbourhood of, the core development area so that early habitat creation and management could be undertaken to render the land suitable as a mitigation area. Such land could be managed in order to function as a receptor site for protected species translocated as a last resort or discovered late in the development process, e.g. for reptiles or amphibia. Equally, the land could be managed to mitigate for unavoidable loss of wildlife resources from within the developed area, e.g. feeding areas for badgers, nesting or roosting sites for birds. The dual advantage of such land for wildlife and public enjoyment, and hence development value, was also considered (see also Town and Country Planning Association [TCPA], 2004).

The idea that land could be acquired and managed as an ecological investment, or ecological capital, prior to or even independently from specific developments, is considered further in this article. This is by no means a novel proposal but it is little used in the UK where the planning and regulatory framework is currently poorly adapted to encourage this approach to mitigation at anything other than a local level and generally on a development by development basis. In some other countries, however, the advance acquisition of land for environmental mitigation

Dr William Latimer, Faber Maunsell, Environment Division, Enterprise House, 160 Croydon Road, Beckenham BR3 4DE, UK. Email: william.latimer@fabermaunsell.com;
David Hill, The Environment Bank Ltd, Crake Holme, Muker, Richmond DL11 6QH, UK. Email: dhill@davidhillecology.com

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has been practised for some years. In the USA the process, termed Mitigation Banking, was pioneered for the conservation of wetlands and has been in operation for over 12 years (US EPA, 2005). It is now entrenched as a mitigation tool and is considered a valid approach in the regulatory framework. Indeed, it as developed into an 'industry' in its own right. Elsewhere it may be termed Conservation Banking, Habitat Banking or Biodiversity Offsets. The principle, well established in the USA, has also been adopted for some schemes in Canada, Brazil, Uganda, Costa Rica, Switzerland and Australia (ten Kate *et al*., 2004) and is under active consideration in a number of other countries (Wende *et al*., 2005). Where regulatory guidelines do not specify such an approach, some companies have entered into voluntary agreements to uphold their environmental commitments and enhance their reputation (ICCM, 2005a, 2005b).

The UK is currently entering a phase of increasing development, in particular for housing and transport networks on brownfield and greenfield sites, the latter due in part to concomitant changes in the farming economy. In the face of continuing pressures on biodiversity in what is often a highly fragmented and intensively used landscape the argument for some form of mitigation banking becomes compelling. This article presents a brief review of the principles involved. A wider ranging review in the international context with some exploration of the business case is provided in ten Kate *et al*. (2004) and for coastal zone management issues in the UK context by Crooks and Ledoux (2000), Crooks *et al*. (2000) and Ledoux *et al*. (2000). Mitigation banking offers an alternative, and in our view often a better, means of mitigating and compensating for biodiversity impacts by providing a mechanism to deliver larger-scale habitat creation, enhancement and restoration schemes in association with planned development. These schemes can be designed, constructed and managed by ecologists within a strategic regional or national framework. The current quality of mitigation schemes is generally poor, inadequately enforced and rarely effectively monitored.

Mitigation Banking and Biodiversity Offsets: A Brief Explanation

Mitigation and Compensation

Definitions for these terms are taken from the Guidelines for Ecological Impact Assessment published by the Institute of Ecology and Environmental Management (IEEM, 2006). Mitigation is used generally to describe measures to reduce adverse impacts. Compensation refers to measures taken to offset or compensate for adverse impacts that cannot be fully mitigated. This generally involves the provision of alternative replacement habitat. Mitigation banks should therefore perhaps more accurately be described as compensation banks, or as noted above, biodiversity offsets, but the term remains in general use (see later).

The Mitigation Bank

The way in which mitigation banking works in the USA at both the practical and regulatory level is explained in some US Environmental Protection Agency documents available on their website (www.epa.gov). Further information on US

and worldwide initiatives can be found on the US websites of the Ecosystem Marketplace (http://ecosystemmarketplace.com/index.php) and Forest Trends (http://www.forest-trends.org/biodiversityoffsetprogram/index.php) and in the UK at the Business and Biodiversity Organisation (http://www.businessandbiodiversity.org/), a site managed by the Earthwatch Institute, English Nature and DEFRA. The principal elements of mitigation banking as undertaken in the US are summarized next.

Essentially, the mitigation bank is established, normally by acquiring land for the creation, or enhancement and management, of habitats or ecosystems for a particular wildlife or environmental resource. The resource is valued in terms of credits and the better the condition of the land in terms of its conservation objectives, the greater the value and the larger the number of credits. Where a development results in unavoidable damage to an environmental or wildlife resource the damage can be mitigated by purchase of credits. In the US, where it is demonstrated that appropriate mitigation cannot be achieved at the development site, it is a federal requirement to mitigate by the acquisition of suitable credits. Credits may also be purchased, held and traded in a process analogous to carbon trading.

Land with environmental and wildlife potential may be acquired by financial institutions, businesses, land-owners or investors and managed to maximize its biodiversity or environmental capital. Credits may then be sold as the land comes into appropriate and stable condition for which the asset was purchased, e.g. land for the management of water resources, the habitat for a protected species. The purchase of credits does not in any way obviate adherence to existing legislation regarding environmental protection, natural resource or wildlife conservation, but may be used where impacts are deemed to be unavoidable. Along with the reduction in ecological risk that comes to the developer with the acquisition of credits also comes a reduction in financial risk; credits for a stable and functioning ecological system can be accurately costed.

The monetary value of the credits is partly a function of the cost of developing the mitigation so that the land is in a condition that can objectively be regarded as functional and stable. The monetary value therefore includes the costs of land acquisition, habitat creation and management, including the costs of design and management expertise. Credits for land set aside for mitigation banking can increase in value as the conservation and management measures result in demonstrable improvements in ecological status, e.g. the establishment of a stable functioning ecosystem, an increase in habitat area or an increase in a viable and self maintaining species population.

Small schemes could be aggregated to provide a larger scheme with a resultant increase in relative biodiversity value, viability and resilience, with more cost effective management and administration. In some cases, it may be appropriate to pursue larger-scale schemes at the outset, avoiding the disadvantages of some smaller scale mitigation measures where the limited area or isolation of the natural system leads to ecological instability and the costs of administration and management are replicated both spatially and over time in separate commissions.

While the process of mitigation banking commenced with the imperative for the protection of wetland ecosystems in the USA, the scheme now encompasses broader habitat and species banks (Bean & Dwyer, 2000), and now, for example,

over 40,000 acres are held as mitigation or conservation banks in the state of California. For a given development impact, credits must be obtained in parity with the resources lost, commensurate with the scale and magnitude of impact. Thus, a wetland unavoidably lost would require credits for a similar system of equivalent function and comparable biodiversity, e.g. loss of coastal marshes would not be mitigated for by credits purchased for inland river basin restoration. Unavoidable onsite losses of an endangered or legally protected species would necessitate credits being obtained in a conservation programme for the same species elsewhere, with the programme showing demonstrable gains in the species population concerned. The appropriate regulatory authorities, often in association with advisory boards made up of the key participants in the schemes, determine the nature and value of credits to be obtained in mitigation for unavoidable environmental losses to development. As a result of the delay in reaching equivalent ecological maturity and adopting a precautionary approach, ratios of habitat provided to that lost can be increased beyond 1:1, i.e. providing more than simple area replacement.

An interesting and successful example of species mitigation banking comes from the USA in respect of the red cockaded woodpecker, a rare and protected species listed under the US Endangered Species Act. This is described briefly in Box 1, with more information available in the article by ten Kate *et al*. (2004).

In parallel to the conservation success of many of the mitigation banking schemes is the financial success of the institutions administering the banks or providing the ecological and conservation expertise. These have seen considerable increases in economic activity, financial value and investment return. There are now thought to be around 150 institutions in the US dealing with mitigation banking. In some respects, the scheme has inverted conservation values; where wildlife conservation in the development context was formerly regarded as a financial drain and a liability, the mitigation banking system has transformed endangered and protected species and habitats into assets with direct monetary, as well as aesthetic, value.

The results of mitigation banking from the US experience appear to be broadly positive in that a number of successful conservation schemes have been achieved. There have been instances, however, where the mitigation measures have been considered weak and adequate compensation for losses has not been realized. These have been attributed mainly to the lack of regulatory supervision and a consequent failure to adhere to the planning conditions originally imposed. It highlights the need for effective implementation, supervision, enforcement and monitoring for any such scheme that might be introduced into the UK in the future.

Mitigation Banking: Its Application in the UK

The Legislative and Planning Framework

The European Community Habitats Directive, enacted in the UK by the 1994 Conservation (Natural Habitats) Regulations, requires the long-term conservation of a range of listed habitats and species deemed to be rare or vulnerable at an international level. The maintenance of these wildlife resources at a ‘favourable

BOX 1. The Red Cockaded Woodpecker (from ten Kate *et al*., 2004)

The habitat of the red cockaded woodpecker is old pine forest with senescent trees where the fire-adapted pines were originally maintained by sporadic wildfires. The species was considered especially vulnerable in view of its often small isolated populations in a fragmented, discontinuous habitat. Managed woodland with even-aged younger trees or a dense understory is unsuitable for the woodpecker.

International Paper, owner of many tracts of pine woodland, recorded 18 family groups of woodpeckers dispersed throughout its forestry holdings in a 1998 survey. The company decided to set up a new 'conservation bank' in one of its larger woodlands which would be managed specifically for a large and stable population of the birds rather than directly for wood pulp. If successful, this would release other woodlands where the presence of species prevented commercial management for the wood pulp industry.

By 2003 the woodpecker population in the reserve woodland had substantially increased to 11 family units, allowing the company to release proportionately, some of its smaller holdings for commercial management. International Paper intends to continue fostering the population of the red-cockaded woodpecker in its reserve forest so as to exceed is original total population holding of 18 family units, thereby generating credits which can be purchased by other forestry companies with small isolated populations of the woodpecker on their land.

The scheme has been considered to be successful. It has allowed the development of a large and apparently increasing population in a large and stable reserve area, other woodlands have been released for commercial use by the company and, finally, it represents a potential future financial resource for International Paper where one 'woodpecker credit' is valued to be in excess of $150,000.

conservation status' is required by the EC Directive and the legislation thus enshrines the principle of no-net-loss to these species and habitats. Where member states unavoidably impinge upon such ecological resources for reasons considered to be in the national interest, where there are no alternatives to the plan or project and where such impacts cannot reasonably be avoided, compensatory mitigation is required to ensure the maintenance of favourable conservation status and no-net-loss, in order to enable the project or plan to be permitted.

The principle of no-net-loss applies to the network of protected sites (designated as Special Protection Areas and Special Areas of Conservation), overlaying the national designation of Sites of Special Scientific Interest (SSSIs), which is the principal means by which the main provisions of the legislation are obtained. It is also applicable to qualifying species that may obtain resources, at least occasionally, outside protected sites. Examples of the latter might include birds from a protected estuary or marshland that may also roost or graze on farmland outside the statutorily protected site or bats from a protected roosting site that forage along adjacent hedgerows. Where such resources within or outside

protected sites may be adversely affected, the statutory regulator will require an 'appropriate assessment' under Article 6 (3) and (4) of the 'Habitats Directive' (92/43/EEC) to be undertaken and, if needed, mitigation (and/or compensation) for any loss of resources that may threaten the affected population. The legislation covering the requirement for appropriate assessments has been significantly strengthened by recent judgements of the European Court of Justice, the Waddenzee case being perhaps the best known (Europa, 2005).

Recent UK government guidance to planning authorities in its Planning Policy Statement No. 9 (PPS 9) takes the no-net-loss principle further and focuses on the requirement to maintain biodiversity at all levels, at plan policy level, in planning application decisions and within and without protected sites. One of the six key principles of the Statement (1.vi) states:

> The aim of planning decisions should be to prevent harm to biodiversity and geological conservation interests. Where granting planning permission would result in significant harm to those interests, local planning authorities will need to be satisfied that the development cannot reasonably be located on any alternative sites that would result in less or no harm. In the absence of any such alternatives, local planning authorities should ensure that, before planning permission is granted, adequate mitigation measures are put in place. Where a planning decision would result in significant harm to biodiversity and geological interests which cannot be prevented or adequately mitigated against, appropriate compensation measures should be sought. If that significant harm cannot be prevented, adequately mitigated against, or compensated for, then planning permission should be refused.

Whilst this statement enshrines the sequential approach when considering the impacts of development on biodiversity, in our view the approach to the use of compensation remains a challenge. As one of the government's objectives for biodiversity in terms of the ecosystem 'services' it provides, there could be clear benefits from a better and more widespread use of compensation. Nevertheless, there is growing evidence that the focus is shifting from an emphasis on the conservation of a select list of rare habitats and species, to this broader approach to the maintenance of biodiversity and functioning ecosystems. This stemmed from the government's commitments under the 1992 Convention on Biodiversity and the Biodiversity Action Plans (BAPs) that have been compiled following ratification of the Convention (see http://www.ukbap.org.uk/UKPlans) The approach is also reemphasized in the government's 2005 *Sustainable Development Strategy, Securing the Future*. Chapter 5 of the Strategy, 'Protecting our Natural Resources and Enhancing the Environment', discusses the need to maintain natural resources at the functioning ecosystem level and recognizes the importance of biodiversity and biogenetic conservation to self-maintaining natural systems. The recently enacted Natural Environment and Rural Communities Act 2006 requires of all public authorities to 'have regard to biodiversity as far as is consistent with the proper exercise of their functions'. The growing awareness and concerns over the effects of climate change is reinforcing the view that ecosystems

need to be conserved in a self-sustaining and resilient state such that their viability is maintained.

While the converging policies regarding the conservation of biodiversity and sustainability might be considered fairly straightforward, the mechanisms at the planning procedural level by which no-net-loss, and indeed the net gains as espoused in national and local BAPs (see later), may be achieved are less clear.

Section 106. 'Agreements' and 'Unilateral Undertakings' are types of Planning Obligations authorized by Section 106 of the Town and Country Planning Act 1990. This allows the applicant to enter into legally binding agreements with the planning authority and which are often used to secure certain works, management or financial support required to offset adverse environmental effects where there is no other clear planning mechanism to obtain such mitigation. This adds power and flexibility to the planning process. However, there remains a substantial gap between what is currently delivered in mitigation schemes and what is promised by developers when signing up to planning obligations, not least because of the inadequacy in the machinery of enforcement.

Such agreements with the local authority usually predicate that the works or mitigation feature operate at a local level, often adjacent to the development. They are usually initiated at the same time or even after the development has taken place. Rarely, therefore, is there sufficient time for created habitats to mature and stabilize for their intended function. Thus there is a temporal loss of ecological resources, which may place populations at risk.

There may also be legal implications in pursuing agreements beyond the administrative boundaries of the planning authority concerned as well as the practical details of supervisory responsibilities and compliance monitoring as mentioned earlier. More importantly, as with a number of mitigation banking schemes in the USA that have been considered unsuccessful, there is often in practice a lack of appropriate regulatory supervision and monitoring after planning permission has been granted. Appropriate management may not be undertaken, leading to failure of the intended mitigation, or the newly created feature may fail to achieve its stated objectives for other reasons, e.g. poor design, small scale or inherent instability over time.

Statutory Requirements and Ecological Principles

Like-for-Like Mitigation

It has been noted previously that mitigation banking does not absolve the developer from any requirements of the regulatory framework or accepted best practice but is to be used as an additional mechanism that may make compliance easier and more effective both at an ecological level and a financial level. The ability to fund a functioning conservation system by the purchase of credits avoids the risk of failure of newly commissioned and often small-scale, piecemeal mitigation schemes, not least because the implementation phase can be taken away from the developer and undertaken by an ecologist.

The no-net-loss principle dictates that where mitigation is obtained by means of credits obtained from conservation banks, these credits should have parity with the losses due to development, both in keeping with the scale of loss and the nature of the loss. The financial analogy would be that the credits are of the appropriate currency and monetary value. Thus, a pond with protected great crested newts necessarily lost to development would require a replacement pond to be created for great crested newts, together with associated terrestrial habitat, both of appropriate size to support at least the same population and preferably a greater number than that which was lost to account for the uncertainty as to the success of habitat creation. Chalk grassland recreated in mitigation for losses to development should be of a similar type of plant community, for example, as defined by the National Vegetation Classification (Rodwell, 1991a, 1991b, 1992, 1995, 2000) and larger in area than that lost to allow for the generality that created habitats are generally at least slightly different than those which they replace and often fail to develop a comparable diversity of plants and animals within a short to medium timeframe. In such cases a ratio of loss to gain of around 1.5 – 2 is the norm, although this can vary between habitats and may be required to be far greater in some cases.

Critical Natural Capital or Non-replaceable Habitats

It has also been noted above, that conservation banks are limited to those habitats that can be created or manipulated to increase their conservation value in terms of their ecological function, component wildlife communities or particular species of conservation concern. Losses cannot be accepted to habitats that are deemed, in realistic timescales, to be irreplaceable. Such habitats or ecosystems are termed critical natural capital, and thus it would not be possible to obtain or trade in credits for such resources. Examples in the UK of habitats deemed irreplaceable include those that have developed under very long time scales, e.g. ancient woodland or peatlands such as raised mires. Other habitats may be very difficult to replicate because of their environmental complexity, e.g. habitat mosaics on complex geology, or intricate relationships between physical and biological factors, e.g. wetlands supplied by underground springs, hibernation caves for bats.

Spatial Relationships between Development Areas and Mitigation Sites

Size. The creation of large reserve areas for wildlife are often more successful in producing stable and self-sustaining populations of the target species and habitats than small isolated sites. Small populations may be vulnerable to random catastrophic factors such as storms, flooding or drought, or suffer the deleterious effects of inbreeding. Small islands of vegetation may be vulnerable to edge effects in terms of exposure (e.g. wind effects on small woodlands) or the effects of invasive species from surrounding habitats (e.g. colonization of tree species into small patches of dwarf-shrub heathland or chalk grassland). It is a common experience of conservation organizations and land managers that some small sites can require a disproportionate effort of management in order to maintain their ecological interest.

There is therefore now considerable interest in developing large-scale reserves, e.g. the various initiatives for the restoration of extensive reedbeds in the Fens, habitats or biotopes sized to support sustainable populations of key, 'flagship' species such as marsh harrier, bittern and otter, animals that require significant areas for feeding or for holding breeding territories.

Location. The location of the area for mitigation also requires careful consideration. It is often appropriate and indeed necessary to replicate lost habitats in the same ecological area to obtain the best like-for-like replacement. In England, for example, English Nature's (now Natural England) countryside divisions termed Natural Areas (http://www.english-nature.org.uk/science/natural/NA_search.asp; or even Joint Character Areas) could be an appropriate unit being areas of similar geology, climate and landscape, e.g. the High Weald, the South Downs, Breckland. It may be possible to make even finer discriminations based on microclimatic factors or soil types.

There are also advantages in enhancing nearby or adjacent sites in mitigation for losses to development for housing or employment with respect to providing a visible and accessible amenity or at least a clear public perception of replacement of valued natural resources.

However, in some cases, the success of mitigation may be compromised by its position in close proximity to the development. These would include mitigation areas for species that are sensitive to anthropogenic disturbances such as visual disturbance from walkers, noise, fires, disturbance or predation from domestic pets. The degradation of certain lowland heaths as an apparent result of new housing developments in close proximity is well documented (Liley & Clarke, 2002; Underhill-Day, 2005) and contributing to the development of local spatial planning policies (English Nature, 2005). Certain species of open spaces, e.g. some bird species, may be intolerant of the visual and physical clutter of the built environment. Onsite or adjacent mitigation may also not be appropriate for busy transport corridors where breeding bird communities may be affected by high levels of road noise or sensitive plant communities exposed to a decline in air or water quality. Breeding ponds for amphibia may be degraded and their habitat corridors severed by new housing developments and their associated road networks. In such cases it would be necessary to seek alternative sites well beyond the range of expected impact. Taken as a whole approach, however, there should not be local or national political resistance to the location of compensation habitats at some distance from that being affected by the development. The key criteria for success should be the contribution the scheme can make to biodiversity enhancement rather than proximity to the source of the effect.

Landscape and Habitat Pattern, Core Sites, Green Corridors and Ecological Networks

The spatial relationships between similar or related habitat formations may also be a consideration where close proximity or perhaps a relatively short linear connection to existing core areas of viable habitats may increase the success of the

new mitigation area by facilitating the interchange of populations along wildlife corridors or landscape 'stepping stones'. The role of green corridors or greenways in the context of metropolitan planning, primarily as a public amenity, is by no means a new concept (Jongman & Pungetti, 2004) but over the last two decades it has received much attention and debate in the context of a deemed value for nature conservation. The principle, given a legal basis by the 1994 Conservation (Natural Habitats, &c) Regulations, is now enshrined in UK Government policy (ODPM, 2002, 2005a, 2005b) for its dual amenity and nature conservation function, in as much as green corridors can provide linear natural or seminatural habitats for human and wildlife dispersion. However, it is important to consider the dispersal capacity and behaviour of the wildlife species in question as considered in a report for English Nature (Dawson, 1994). Dispersal capacity along linear corridors is clearly in part related to the nature of the corridor, its habitats and its landscape or townscape context but the capacity for wildlife to move along such corridors or negotiate stepping stones is also highly species specific (Wood & Pullin, 2002; Angold *et al*., 2006). It is increasingly becoming evident that such corridors, as a ready transmission corridor, may be of benefit to perhaps a rather limited number of species (Forum für Wissenschaft, Industrie und Wirtschaft, 2001; News@ Nature.com, 2001) and it is the habitat patches so connected that should be regarded as the key.

More recently the basic principle of landscape connectivity has been extended to a consideration of ecological networks as a wildlife conservation strategy in landscapes that have been extensively fragmented by intensive agriculture, urban development and transport corridors. It is considered that the network should consist of a framework of ecological components providing a range of core habitat areas, corridors and buffer zones in order to sustain the set of physical and biological systems necessary for ecosystems and species populations to survive in a human-dominated landscape (Jongman & Pungetti, 2004). From this definition, it is clear that ecological networks are more than a mere latticework of linear connections, rather they should comprise broad landscape connections with mosaics of habitats present which may include linear features as well as spatially and ecologically diverse habitat patches or core areas. Thus, the potential for wildlife dispersion is increased by the provision of a diversity of habitat 'stepping stones' and a diverse orientation of physical links as provided by woods, hedges and river corridors and catchments. A number of European states are adopting this principle in their regional and national spatial planning strategies (the Estonia Green Network, http://www.iucn-ce.org/econets/database/?id=4http://www.iucn-ce.org/econets/database/?id=4; Jongman, 2002, 2003; Vuilleumers & Prelaz-Droux, 2002). A number of planning authorities in the UK cite policies on wildlife corridors and simple linkages may be provisioned at a local level. PPS 9 (para. 12) also urges action on networks of natural habitats. However, positive action on the ground to provide core areas and adequate linkages is slow and at a strategic level the principle has yet to gain prominence in the UK (Hodcroft & Alexander, 2004). Nonetheless the concept is now being debated in the UK through Natural England and the Institute of Ecology and Environmental Management (a joint conference on Ecological Networks is taking place in November 2007; www.ieem.net). It is likely that more concerted action in support of ecological networks,

provisioned at a range of spatial scales, will come forward in a relatively short period of time.

The expected impacts of climate change are reinforcing views on the necessity for functional and well planned ecological networks at a regional and national scale so that population movements along latitudinal or altitudinal gradients may be facilitated (Bright, 1997; UNEP/CMS & DEFRA, 2006) As noted above in relation to green corridors, it is nevertheless important to consider the dispersal capacity and behaviour of the target species; inherently sedentary species, e.g. most plants, terrestrial molluscs etc., may not benefit from such a strategy and even some apparently highly mobile species may be behaviourally disinclined to move between dispersed habitat patches. The experience of the red kite reintroduction to lowland England is one clear example of a physically highly mobile species being strangely reluctant at the behavioural level to extend its range much beyond the home range or new region of release. Community relationships such as commensalism, competition and symbiosis add an additional level of complexity in relation to the capacity for species dispersal. While it may be envisaged that mitigation banking could supply one of the principal mechanisms for the provision of ecological networks, the extent to which habitats can, or should, be manipulated in order to accommodate the predicted effects of climate change will need careful and detailed consideration based on sound data concerning the species or habitats involved.

The Nature of the Land for Acquisition: The Starting Point and the Desired Objectives

Local climate, geology, soils and drainage will determine the scope for habitat creation, the operations required and the nature of the habitats that may be successfully established. These factors are likely to be of more importance than the nature of the existing land use. There are numerous examples of a variety of successful habitat creation schemes on former industrial land, brownfield sites, mineral extraction sites, landfills or areas dominated by intensive farming or forestry and the techniques for successful creation, given appropriate time scales and expertise, are becoming increasingly better understood (Gilbert & Anderson, 1998; Ecoscope, 2001).

Mitigation banks may be established by active habitat creation, normally starting from bare substrates, habitat restoration when there is a remnant habitat type remaining, or habitat enhancement by some form of management, which is normally required to some extent in most cases over the long term. Habitat creation therefore requires active intervention, for example by landforming, manipulation of drainage regimes and subsequent planting. Desired habitats may also be obtained by facilitating natural processes, e.g. restoration of river floodplains and managed coastal retreat by the removal of flood defences and sea walls, while in some cases, habitat restoration could include simple non-intervention to allow for natural ecological succession to the desired stage. It may be possible, or indeed necessary, as in the case of farmland as discussed later, to manage for certain habitats or species while sustaining other forms of land use.

Timescales for Habitat Development and Ecological Succession

Where the habitats of the mitigation bank can be created well in advance of its requirement for compensation for losses to development, the uncertainty as to the success off mitigation in the early phases is reduced and the process of ecological succession and habitat stabilization over time render the habitat better suited for its purpose. Timescales for habitat creation vary according to the type of habitat. Ponds may be available for colonization by protected amphibian or aquatic insect populations within one or two years; species-rich grasslands may take four to five years, with appropriate management, to stabilize; mature scrub mosaics or hedges 10 – 12 years, while woodlands will clearly take many decades to mature. As noted in earlier, the very long timescales for the formation of certain habitat types render the habitats essentially irreplaceable. The principle that newly created habitats should be in place in appropriate condition for their compensatory purpose is noted in Paragraph 30 of the UK Government's Circular on Biodiversity and Geological Conservation (ODPM, 2005a).

The important advantages in ensuring that habitats undergo the correct development period are therefore:

- The longer the period of development, the greater the likelihood that some measure of habitat stability is achieved, though this is often reliant on the correct management regime.
- The risk that the habitat may not develop as planned declines over time, or remedial action may be taken in good time to ensure success.
- The habitat is better able to fulfil its intended biodiversity function.
- The value of the credits for the habitat increase over time, in keeping with greater stability, habitat quality and the assurance that the habitat will fulfil its objectives, the value being partly a function of these acquired characteristics, and partly reflecting the accumulated costs of management over time.

The ability to produce mature and stable habitats is perhaps the key advantage of the mitigation banking system, as long as the bank is correctly regulated and monitored.

Mitigation for Habitats and Species without Statutory Protection

Statutory and planning procedures usually define and guide the mitigation objectives required in the UK by EC directives and national law though it is the responsibility of the developers or proposers of the scheme to procure the practical arrangements and long-term resourcing whereby successful compensation for losses can be secured.

For habitats and species without direct statutory protection, there is an increasing emphasis on similar mitigation being provided for any losses of biodiversity due to development. This has recently been emphasized in the UK Government's PPS 9 (OPDM, 2005a; see earlier). While the specific wildlife elements comprising biodiversity are not defined in the Policy Statement, key species or habitats that are considered vulnerable and which have shown a

considerable decline in population levels are often the subject of BAPs, either at a national or local level.

For the habitats and species listed in the BAPs there is some legislative impetus in as much as Section 74(1) of the Countryside and Rights of Way Act 2000 (CRoW; as amended by the Natural Environment and Rural Communities Act 2006) places a duty on Ministers and Government Departments 'to have regard' to the purpose of conserving biological diversity in accordance with the UN Convention on Biological Diversity 1992. The key species or habitats for which there are UK BAP targets are listed under Section 74 of the CRoW Act. In addition, Section 40 of the Natural Environment and Rural Communities Act 2006 extends to all public authorities the existing Section 74 duty to 'have regard to biodiversity as far as is consistent with the proper exercise of their functions'.

In addition to BAP and Section 74 habitats and species, the Red and Amber lists of bird species of conservation concern (JNCC, 2002) and the Red Data books, which list endangered animals and plants (see http://www.jncc.gov.uk/page-2133), point to additional species where conservation action is vital in order to retain the species with a favourable conservation status. Often habitats beyond the scope of many BAPs, e.g. scattered scrub or unmanaged grassland, habitats that are often uncommon because of their transient nature in ecological succession, make a significant contribution to biodiversity at the local scale. Similarly, while BAPs recognize the importance of retaining core habitats, often habitat mosaics receive less recognition for the number of species that benefit from the complexity of edge and transitional microhabitats present.

While mitigation banks could be developed to permit compensation for BAP species and habitats lost to development, it would clearly be inappropriate for gains within the banks to be counted as progress towards BAP targets for key habitats or species and the development of mitigation banks should not, in any way, reduce the effort to promote the favourable conservation status of these species. Nevertheless, in some cases the presence of core populations within the banks, developed to compensate for losses elsewhere, may make a temporal, local contribution to species recovery outside the banks where favourable habitats exist.

Development in Farmland: A Case in Point

With increasing pressure on greenfield sites and greenbelt land (Barker, 2006) for expansion of housing, transport and employment in many parts of the UK, development can impinge upon the suite of wildlife species typical of the mosaic of farmland habitats, a community already much depleted by intensive farming. While it is often possible to retain core areas for target species or habitats within these developments, e.g. small woodlands with badger setts, ponds or protected hedgerows, there is often little long-term postconstruction monitoring undertaken to demonstrate the success of such actions in relation to biodiversity. The theoretical concern is that isolated populations become more vulnerable if small in numbers and lose their connectivity with other populations as a result of severance or constrictions in the corridors for dispersion.

Equally, species may lose other vital resources such as foraging areas or wintering sites, which should always be considered for retention and sized so as to

supply the needs of the species during the most limiting or demanding times such as during climatic extremes (e.g. cold winters, hot dry summers) or during the breeding season. Invariably, the characteristic and declining species associations that depend on the mosaic habitat structure and extensive open space remaining in much of farmland Britain are displaced by developments for housing and roads to be replaced by commonplace species of the urban edge and suburban gardens. Thus, distinctive species such as brown hare, and birds such as barn owl, lapwing, corn bunting, yellowhammer and grey partridge, are lost from these areas with gains in the more common 'garden' birds. Both the rarer arable-land plants such as cornflower and purple ramping fumitory, and the more widespread species such as poppy and field pansy, together with common ruderal plants of disturbed soils, species that supply food for a range of farmland invertebrate and birds, rarely survive in formal open spaces managed for public use (see the Game Conservancy Trust – www.gct.org.uk – the main organization researching the link between arable weeds and farmland birds).

The concern over the loss of species characteristic of arable farmland is highlighted by the suite of action plans for arable species and habitats within the UK BAPs and summarized in Chapter 4 of the Government's Biodiversity Strategy for England (DEFRA, 2002a). The techniques required in order to realize the objectives of these action plans are becoming increasingly well established through the experience of Environmental Stewardship schemes (see later) and dedicated research (Tattersall, 2000; Lawson *et al*., 2004; Winspear & Davies, 2005).

As attention is increasingly drawn to the loss to overall biodiversity and the specialist species present on farmland, the statutory conservation agencies and planning authorities are likely, in accordance with the requirements of PPS 9, to seek appropriate mitigation for such losses due to development. The advance acquisition of biodiversity credits in species and habitats characteristic of farmland habitats appears to be increasingly tenable given current concerns over landscape conservation, intensive agriculture, food quality and the rural economy.

Whole Landscape Conservation

By supporting a farming system geared towards conserving declining animal and plant species of increasingly rare farming landscapes, a number of gains, in addition to those to biodiversity, may be made. Evidence is accumulating to suggest that organic farming methods not only produce increasingly sought-after products with a high market value but also support a landscape that offers sustainable production with a higher biodiversity than modern conventional intensive farming (*New Scientist*, 2004), particularly with respect to insect species that then sustain declining species such as bats (Wickramasinghe *et al*., 2004) and insectivorous birds such as swallow and spotted flycatcher. Thus, agricultural land use that aims for higher biodiversity does not preclude the production of high-value produce and the organic approach is now seen as a viable sector of the UK agriculture industry with acknowledged benefits for sustainability, biodiversity and the rural economy (DEFRA, 2002b, 2004).

Payments for biodiversity credits held by land-owners who conserved the rarer species upon their land could assist in keeping land-owners or tenant farmers and

their employees working on the land, thereby assisting the rural economy. Management for biodiversity often requires a higher level of skilled application whether applied to the management of rotational farming, sound and sympathetic animal husbandry, maintenance of farm woodlands and hedges by coppicing and laying, or the management of flood plains to allow seasonal flooding for both wildlife and flood attenuation, or for the operation of water meadows.

Landscapes farmed in part for biodiversity objectives are likely to have a higher visual appeal than those under intensive agriculture, which often result in rather forbidding and constrained environments for ready public access. Biodiverse landscapes would have an enhanced high value for public enjoyment in the use of footpaths, bridleways and areas appropriate for other quiet use as open space. Exchequer funding in the form of Environmental Stewardship schemes and farming support in Environmentally Sensitive Areas is a measure of government concern over the loss of diverse and sustainable landscapes. The Rural Strategy (DEFRA, 2004) presents a Government vision of a living, working, protected and vibrant countryside comprising sustainable rural communities where economic, social and environmental issues are all taken into account. A system of mitigation banking applied to whole landscapes could, where appropriate, transfer some of this commitment more properly from the public purse (one of the objectives of the Governments sustainable farming strategy (DEFRA, 2002b) to the developer where compensation for the loss of farmland biodiversity is required. The system would benefit those existing whole landscape initiatives where progress and long-term management may be limited by the uncertainties and unpredictability of piecemeal funding (Wall, 2006). As noted earlier, such initiatives could also be spatially designed to deliver the ecological networks needed to enable the dispersion of species across the wider landscape, from local, through regional, even to national dimensions, providing one of the prerequisites for mitigating the effects of climate change. This would create an abundance of places that people can visit, thereby complying with the government's health agenda: studies show the substantial value to health and well-being of physical exercise in the countryside (Henwood, 2003; Brown & Grant, 2005; Bird, 2006). Use of such areas may also relieve pressure on the more vulnerable, protected sites thereby incidentally assisting in progress towards government targets for restoring the SSSI network in the UK to favourable condition (Everett, 2004).

Delivery of the Mitigation Banking System

With no formal system in place for a nationwide approach to mitigation banking, the approach at present would rely on partnerships between financial institutions and land management or conservation agencies, with a role in the latter for both the non-governmental and statutory sectors. There is, however, nothing to prevent developers from acquiring additional land and managing this in order to provide for future mitigation needs. However, we believe such acquisition, or establishment of land is more appropriately done through a third party working independently of the developers and relieving them from the specialist work of ecological mitigation design, construction and management. Informal discussions between the authors and developers along these lines suggests that this is also their

favoured option should it be feasible to take mitigation banking forward in the near future.

Regulatory supervision, as with the carbon trading scheme administered by the Environment Agency, would be most properly undertaken by the appropriate government conservation agencies Natural England, Scottish Natural Heritage and the Countryside Council for Wales, though it is highly likely, and clearly desirable both for the regulators and the development industry, that these agencies would require that the client or developer seeking biodiversity credits should obtain the assistance of professional ecologists for guidance as to the details of the credits sought.

There is a real opportunity to obtain much greater gains for biodiversity, landscape and nature conservation, through the implementation of a mechanism based on mitigation banking, which allows funds to be aggregated from a range of development projects in order to implement habitat creation, restoration and enhancement, at large spatial scales. We propose that such a mechanism is enshrined within the planning process in the UK.

Summary

Mitigation banking is essentially the advance acquisition of established, accredited environmental capital so as to offset losses to development. It has been in use in the United States and in a number of other countries for some years. Analogous with emissions (carbon) trading, it is not always necessary to trade directly in the commodity itself; credits can be obtained where an appropriate institution has acquired the natural capital for appropriate and approved management and for trade.

While the system is little used in the UK, there is an increasing necessity, stemming from the requirements of the EC Habitats Directive, to assure no net loss of biodiversity. This requires appropriate habitat compensation on a like for like basis where statutorily protected habitats or species listed in the Directive are adversely affected by development. The approach is also relevant to the mitigation of ecological impacts in the wider countryside, i.e. away from protected sites, since there is significant evidence that mitigation provided within a development site is largely of limited value, rarely enforced or monitored. A better system is now required within the planning process.

With increasing concerns over the loss of biodiversity, and stemming from government advice to planners, there is likely to be a trend towards like-for-like mitigation being required for habitats and species not currently listed for statutory protection but that nevertheless contribute to the nation's biodiversity. Such habitats and species would normally be expected to be the subject of Biodiversity Action Plans and included in the CRoW Act Section 74 list. There may be in certain cases additional habitats, particularly mosaics, and species where losses to development could be considered to be an adverse effect on biodiversity and for which mitigation could be required. Farmland habitat mosaics are a possible example of this and with appropriate enhancements as necessary could also deliver significant benefits in landscape connectivity in addition to places where people can gain an experience with nature and the natural environment. Acceptance of the value of such ecological networks to ecosystem function and pubic amenity is a key

TABLE 1. Mitigation Banking: Summary of Key Issues

Key feature	Notes/related issues
Advance acquisition of land with the potential to develop natural capital, offering appropriate timescales for habitat creation, manipulation and management for defined biodiversity objectives.	May be undertaken by the developer, investor, land-owner or through an accredited institution. Requires 'up-front' investment for acquisition, habitat creation and appropriate management.
Allows the acquisition of high value biodiversity credits for current or later use.	May be acquired and retained by the developer, or another institution, for investment purposes or trade. In the USA ownership does not pass to the developer but is usually held by a third party. While intended for planning gain, mitigation banking may have relevance to the forthcoming EU Environmental Liability Directive.
Obviates the ecological risk attached to new mitigation schemes and minimizes financial risk by permitting accurate costing of credit acquisition.	
Value of credits is a function of total costs of land, habitat creation and management expertise.	Credits can increase in value over time as habitat systems mature and populations increase, providing greater offset potential.
Critical Natural Capital, i.e. irreplaceable assets cannot be traded.	In the UK, CNC would cover such habitats as ancient woodland, raised peat bogs or complex spring-fed wetlands.
Habitats created or suitably managed in advance can be demonstrated to be successful and stable.	Avoids the risk of biodiversity losses between development and the maturation of stable habitats, mitigation failure or the failure to convince the regulators that the promised objectives can be secured.
Does not obviate adherence to existing legal and best practice requirements on the development site.	Credible mitigation or biodiversity offsets may allow a more flexible approach to development on site.
Enables better gains in biodiversity by encouraging management of larger areas.	Avoids piecemeal and potentially unsuccessful mitigation schemes.
Mitigation may be pursued where gains can be maximized, i.e. nearby for ready public appreciation or more distant beyond the range of development related disturbance.	Mitigation can be tailored to the needs of the habitats or species under threat; systems vulnerable to disturbance can be managed beyond the influence of disturbance.

(*continued*)

TABLE 1. (*Continued*)

Key feature	Notes/related issues
Highly suitable for whole landscape or farmland mitigation with species reliant on extensive areas, cultivated ground or habitat mosaics.	Can have considerable added benefits for landscape value, high-value (organic) foods, the rural economy, sustainable farming.
Investment in whole landscapes can provide flexibility to cater for special mitigation needs undertaken in context of required adjacent habitats or dispersal corridors and networks, e.g. feeding areas for certain animal species adjacent to core breeding or hibernation sites.	Examples could include construction of new ponds for protected amphibian species with suitable terrestrial habitat, enhancement and adaptation of existing buildings, or construction of new structures for bats adjacent to woodland, hedgerow or wetland feeding areas.
Whole landscape enhancements and conservation is required for the provision of regional ecological networks facilitating longer range dispersion of certain species.	Assists in the prevention of the 'island effect' and habitat isolation in fragmented landscapes. Provides one of the prerequisites for the mitigation of the effects of climate change.
Efficient and knowledgeable regulatory control and supervision needed for mitigation banking to succeed.	Many examples of successful schemes but equally a number of failures that have been ascribed to poor regulatory control.
Greater security provided to the development industry allowing them to get on with what they do best.	Also allows greater security of delivery of biodiversity as professional ecologists are responsible for design, construction, management, monitoring and reporting.

feature of regional planning in a number of European states and regions. It is seen as one of the strategies to mitigate for severance effects in fragmented landscapes and the anticipated effects of climate change. Provision of better structured landscapes of higher ecological value than currently exists, together with access provision as appropriate, would relieve recreational pressure from protected sites and encourage more people to visit the countryside and to benefit from the physical and mental health benefits that would accrue from such an experience.

Under UK planning law, Section 106 agreements offer a flexible approach to undertaking the appropriate mitigation to offset development losses to biodiversity. There is, however, little experience in its application beyond the boundaries of the planning authority responsible for determination of the relevant application and timescales are often too limited for the provision of stable compensation habitats that can adequately mitigate for development impacts at the time of loss. In some cases it may be possible to enter into an agreement with the appropriate statutory regulator, e.g. English Nature, who can then demonstrate to the respective planning authority, or authorities, that the relevant undertakings have been entered into and that appropriate mitigation has been, or is likely to have been obtained. As the Environment Agency now administers the Emissions trading scheme, the future may see the statutory agencies for wildlife conservation administering a system of mitigation banking and the trade in biodiversity offsets and credits.

Table 1 summarizes some of the key features, opportunities and issues associated with mitigation banking.

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