# BIG PLANS AND LITTLE PLANS: DELIVERING LAND USE CHANGE DESIGNED BY LANDSCAPE ECOLOGY

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**Abstract**
In this paper I describe some of the ways in which landscape ecology principles have been incorporated into land use planning and change. In Scotland we have tried developing landscape-scale or regional plans for land use change to resolve issues of habitat fragmentation – the 'big plans' of the title. We have also developed 'little plans' – much smaller proposals based on individual designated sites. My conclusion is that both of these approaches are weak in directing land use change at the scale necessary, and that a system which 'scores' land manager-generated proposals is a more useful new approach.

*Keywords*: landuse planning; connectivity; incentive; network; woodland

## 1. Introduction

There is a large body of work within landscape ecology that illustrates the relationships between spatial patterns of land use and the maintenance and restoration of biodiversity. There are also many suggestions for the practical application of landscape ecology in changing land use: this paper describes three methods used in the Highlands of Scotland with particular reference to woodland biodiversity in very fragmented woodland habitats.

## 2. Principles and Practice – the impact of new tools

The principles behind landscape ecology are by now familiar to many, with the island biogeography work of Macarthur stimulating a flood of research that has amply demonstrated a general association between fragmentation and species/population decline. Equally many writers have recognised the potential value to biodiversity of reversing recent or historic fragmentation – a value whose importance has increased as we understand more about the nature of climate change.

Of course, the application of general principles to the real world presents immediate problems – what exactly do we mean by fragmented? Of the many choices of land use change available, which is the best? Since, at least in woodland systems, the rate of change can be rather slow, it is not possible (especially under the threat of climate change) to wait for multi-decade experiments to provide answers. We therefore need to use a predictive approach to help us apply the general principles to specific situations.

There is of course considerable debate about the alternative approaches to predicting the outcomes and value of land use changes for biodiversity objectives, ranging from landscape metrics to a focal species modelling approach. A number of reviews of the use of these have been published – for example Humphrey et al. (2005).

In Scotland we have most strongly followed a focal species modelling approach using the BEETLE model developed by Forest Research (FR) as part of a suite of tools being constructed within FR's Landscape Ecology Project. Instead of using metrics as surrogates for understanding the meaningful processes of species-landscape interactions, BEETLE tests the landscape pattern against ecological profiles for 'focal' species. The model runs within ArcView GIS (ESRI) allowing integration of a wide range of land cover data within the modelling process (Watts et al. 2005)

The use of the BEETLE model allows us both to analyse the fragmentation and connectivity of focal species in real landscapes, and to predict appropriate changes to land use to reduce fragmentation. Since real land use choices are always made in hectares, metres and grid references, we have found the BEETLE approach to be very useful for influencing land use change since it predicts spatial outcomes using this spatial language.

## 3. Models of land use planning using spatial modelling

Scotland is similar to many countries in that it develops strategic plans for land-based industries or land use in general. However these tend to be characterised objectives that are aspirational or thematic, rather than measurable and precise, and they are certainly not spatial plans in any but the vaguest degree. Even at regional levels these tendencies remain, with the result that there is almost no way that the logic and principles of landscape ecology can be incorporated into the way land use choices are made through these plans. Furthermore, these strategic plans are based on land use change being almost exclusively driven by the state, through financial incentives for private landowners to change their management. High levels of in-

centives combined with small overall budgets mean that the amount of land use change that the state can engineer is small, which only makes the lack of any spatial element in the planning more damaging. For example, recent agri-environment measures in Scotland have included measures to support populations of ground-nesting birds in farmland areas. One of the key species in this category – Corn Bunting (*Miliaria calandra*) – has its last major remnant population in Fife in Eastern Scotland. As the map (Fig. 1) shows, the lack of spatial planning in the delivery of these agri-environment measures means that virtually all of the fields managed for ground nesting birds were distant from the sites where these fairly sedentary birds actually occur.

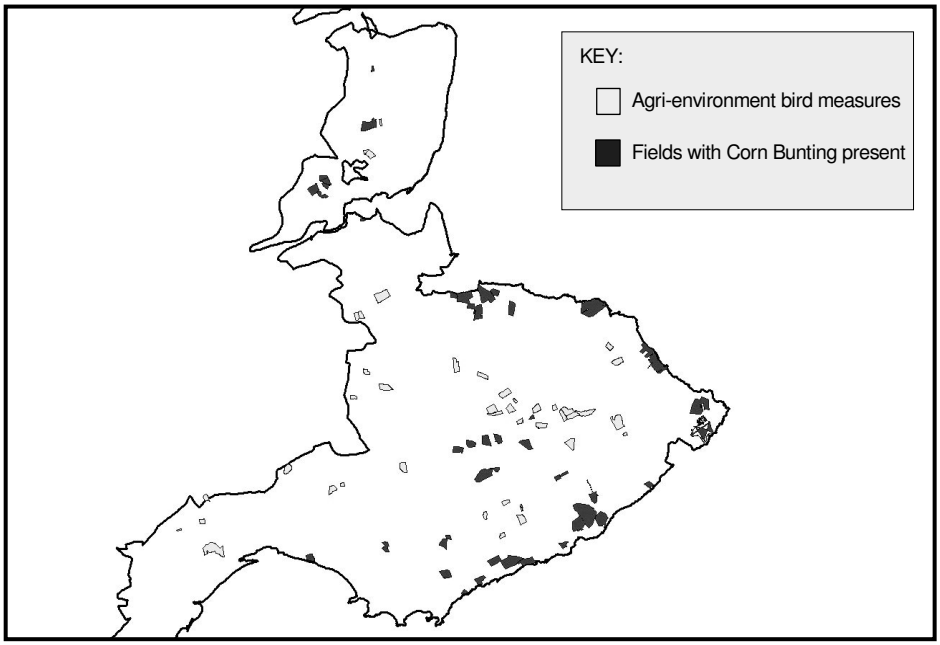


Fig. 1. Corn Buntings in Fife (from Humphrey et. al. 2007)

So, if a lack of any spatial element in planning can be so damaging, what are the alternatives? In Scotland we have broadly considered, and to some extent tested three different alternatives:

## 4. Results

### *4.1. The Big Plan*

There is persistent enthusiasm for developing regional scale plans which seek to optimise land use and spatial patterns to deliver maximum benefit for a range of biodiversity objectives. Proposals have been put forward a number of times, and

perhaps the strongest example in Scotland is the Cairngorms Forest and Woodland Framework, developed in 1999, covering what is now the Cairngorms National Park. This included specific locational proposals for new woodland in order to develop large woods from existing clusters of woodland, and develop connections from existing linear clusters of woods. Few if any of these locational proposals have been delivered in the last 8 years, even though there has been land use change in the area. There will be several reasons why this plan has not been effective, but I consider the fundamental weakness of it was that it considered only woodland, and could not easily take into account the priorities and motivations of the private landowners it sought to influence. In a sense, it did not go far enough in terms of detailed planning, because it didn't consider every aspect of the land use change decisions it sought. However, such a detailed large scale plan would be impossible, not only because it would be hugely complex, but also because it would require the resolution of a mass of competing objectives (both state and individual) which are simply not resolved in conservation or land management. The classic example of this is that both Habitat Action Plans (JNCC 1995/1999) for Caledonian Pinewood and dry heath envisage significant expansions in area. Since these habitats are both competing for low/mid altitude dry infertile site types, it is not possible to have both Action Plans delivered – a familiar zero-sum outcome. So in summary, the fundamental weakness of the Big Plan approach has meant that while it has often been advocated, we have yet to see it seriously attempted.

### *4.2. Little Plans*

An alternative to the Big Plan is to reduce the impossible complexity by reducing the scale, and focussing on small sites only where the issues are simple and sufficiently well understood to allow spatial planning. We are currently undertaking a project that does this by analysing the degree of fragmentation of certain features on our nationally or internationally designated sites, and assessing the quick wins – opportunities to reduce fragmentation by land use change within or adjacent to the designated site. A pilot study at Beinn Eighe National Nature Reserve in the Highlands demonstrated that the pinewoods there were likely to be fragmented into two blocks, and that the site was also isolated from the nearby pinewoods at Coulin. Fig. 2 shows the pinewood habitat networks around Loch Clair where the modelled dispersal has only two 'high cost' connections – i.e. connections with a low probability of making an effective connection between habitats.

However our analysis also showed that a 20 hectares expansion of the woodland could produce 'low cost' connections throughout the network – i.e. connections with a high probability of making an effective connection between habitats. This therefore could build a chain of functionally connected pinewoods – a network substantially bigger and therefore more robust than the previous woods. Because

the analysis demonstrated big benefits for small costs, it is likely that the woodland expansion and connection will now occur.

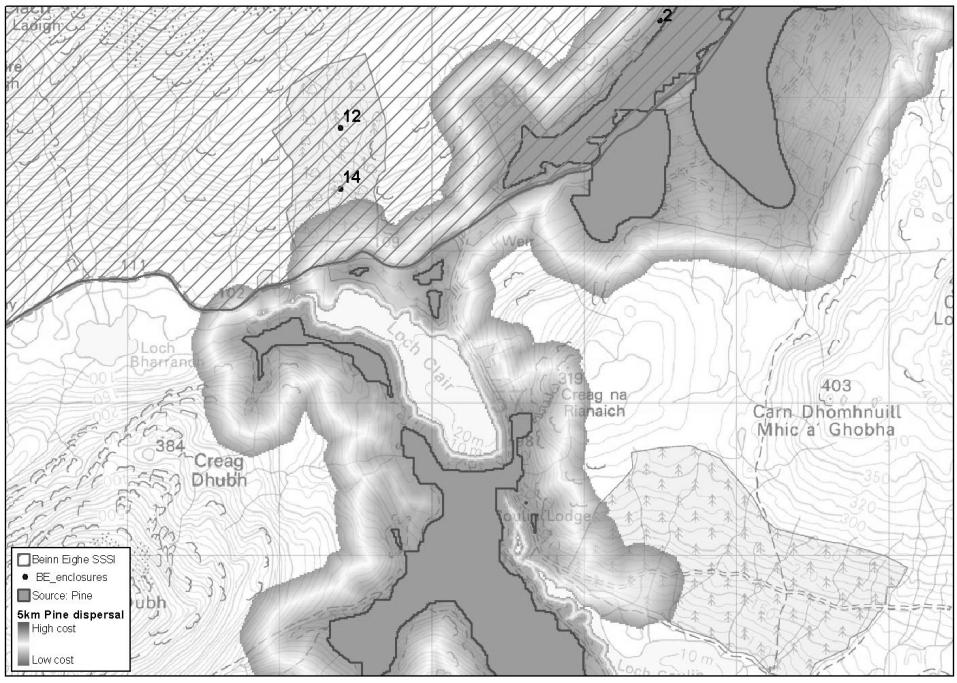




Fig. 2. Dispersal network for pinewood specialist species

Of course, such Little Plans are not a large scale plan, even if there are many of them, and they do not provide any help in considering spatial planning beyond their necessarily limited area.

### *4.3. Scoring proposals using spatial criteria*

Incentives for land use change are normally calculated on an area basis – so much money for each hectare of activity or change. Commonly they are restricted by the condition or importance of the area. In the Highlands we have one example of an incentive programme which combined these with an additional, substantial payment for the amount of connectivity provided by a new woodland – a payment for ecological function. This Highland Locational Premium (Forestry Commission 2006) was designed to reward landowners who reduced the fragmentation of semi-natural woodland, but without any formal plan or map to direct them. In essence the scheme calculated the size of the habitat network which would be created by a

proposed planting, and what payment applicants could expect for the size of network created. Applicants were invited to attend a series of discussions where they could bring their proposal, and have them tested through the BEETLE model to discover how valuable it might be in terms of creating connected networks. In about 5 months of 2006 the scheme agreed £1.6 million in additional premium payments, paid on 400ha of new woodland which made new links for 41 networks into a total of 8500ha of woodland networks. This is regarded as a very satisfactory outcome. Rewarding the ecological function, rather than using a prescriptive map-based approach, released the creativity of forest managers, and achieved a reduction in fragmentation at a lower cost – because landowners could decide for themselves where woodland creation was acceptable, and fitted with the needs of their landholding best.

## 5. Discussion

The use of a scoring approach to spatial planning has given us a new tool for the delivery of land use change to provide us with, in the old foresters' saying, the right tree in the right place. It is complementary to the Little Plans – we certainly wish to pay attention to the most important sites and to see them less isolated and fragmented – but a scoring approach enables us to reduce the overall fragmentation in the countryside at a low cost, and without extensive planning processes. In many ways the combination of these ideas perhaps gives us a basis for larger scale plans where there are some detailed elements – where a formal planning approach has been applied, and wider areas that have no explicit planning, but where incentives will be directed through scoring criteria to meet a range of objectives. This approach – a new type of Big Plan combining Little Plans and a wider scoring approach – may well be important in dealing with climate change, where the primary biodiversity planning need is to create connected routes through which species can move and adapt to changing environmental factors.

This scoring approach also opens the door to a new way to interact with those influencing land management decisions. One of our intentions is to provide general access to the modelling tools, perhaps by hosting a system and allowing internet access to what-if analyses. Interested land managers and others would be able to test land-use change proposals to see their impact on habitat networks and connectivity. By linking this to a scoring/incentive approach, we could really harness the creativity and vision of land managers without the limitations of map-based top-down strategies. It could also become a tool to support wider sustainable development – allowing developers, consultants and communities to identify least damaging proposals, or offer intelligent, functional mitigation responses to development losses. And above all, it provides a way to combine technical ecological principles

with site-based knowledge in a way that respects the strengths of both ecologists and land managers.

## References


Humphrey, J. W. – Smith, M. – Shepherd, N. – Handley, P. (2007): Developing Lowland Habitat Networks in Scotland: Phase 2. Final report to Forestry Commission Scotland, Forestry Commision GB, Scottish Natural Heritage and Scottish Executive Environment and Rural Affairs Department

Humphrey, J.W. – Watts, K. – McCracken, D. – Shepherd, N. – Sing, L. – Poulsom, E.G. – Ray, D. (2005): A review of approaches to developing lowland habitat networks in Scotland. Scottish Natural Heritage Commissioned Report 104 (ROAME No. FO2AA102/2). Scottish Natural Heritage, Edinburgh

Watts, K. – Humphrey, J.W. – Griffiths, M. – Quine, C. – Ray, D. (2005): Evaluating Biodiversity in Fragmented Landscapes: Principles. Forestry Commission Information note 73 http://www.forestry.gov.uk/pdf/fcin073.pdf/$FILE/fcin073.pdf

JNCC (1995): The UK Biodiversity Steering Group Report. Volume II: Action Plans (Tranche 1, Vol 2, p259) Joint Nature Conservation Committee http://www.ukbap.org.uk/UKPlans.aspx?ID=6#4 and

JNCC (1999): UK Biodiversity Group Tranche 2 Action Plans. Volume VI: Terrestrial and freshwater species and habitats (Tranche 2, Vol VI, p217) Joint Nature Conservation Committee http://www.ukbap.org.uk/UKPlans.aspx?ID=16#4

Forestry Commission Highland Locational Premium 2006 – 2008 Guidance http://www.forestry.gov.uk/pdf/HighlandLocPrem06-08.pdf/$FILE/HighlandLocPrem06-08.pdf 2006.