STRATEGIC ECOLOGICAL ASSESSMENT OF ROAD DEVELOPMENT

Timothy Moffat and Peter Hankard

Introduction

Linear developments such as roads often affect large areas and impinge on a number of habitats. They can therefore have consequences for the conservation of biological diversity, including habitat loss, habitat fragmentation, pollution and disturbance. Sustainable development requires that environmental considerations be integrated into the planning and regulation processes of Government. So at a strategic level, it will be important for policy makers to understand the potential cumulative ecological effects of the combined land take by current and planned road networks. The case study focuses on illustrating the compatibility of road developments with safeguarding an internationally important and protected wildlife habitat, lowland heathland, and its associated protected species. As a first step in the strategic assessment of possible damage due to road development, the case study demonstrates how the Countryside Information System (CIS) can be used to establish spatial relationships between the potentially affected wildlife habitat, its associated species and the existing road network.

The Policy Framework

The Highways Agency's *A New Deal for Trunk Roads in England* reports on the Government's review of the roads programme. One of the main aims of the review was to find ways of reducing the adverse impact of trunk roads on the environment, and to formulate policies that aim to support the protection and enhancement of the natural environment. To this end the Highways Agency intends to operate a strong presumption against major new transport infrastructure which damages environmentally sensitive areas, and to manage the trunk road network to support the protection of species and habitats.

Data Sources

There is no universally accepted, national distribution map of lowland heathland available for the case study. Because the accepted definition of "lowland heathland" incorporates an altitudinal threshold and vegetational characteristics, a map of lowland heathland can be derived from three data sources:

(1) The Ordnance Survey (OS) digital 1:250,000 Strategi data, customised into a topographic data set for CIS, can be used to distinguish between "upland" and "lowland" heathland.

(2) A plant species richness map for lowland heathland can be created using published constancy tables from the National Vegetation Classification (NVC) and species data from the Biological Records Centre (BRC) at Monks Wood. The NVC constancy data can be used to identify species characteristic of the lowland heathland vegetation types, and the BRC species distribution data for 10 km squares can be used to map the co-occurrence of species found exclusively or predominantly in lowland heathland communities.

(3) The Land Cover Map of Great Britain (LCMGB) derived from satellite imagery, includes a "dense shrub heath" land cover type. This cover type can be used to estimate the national distribution of vegetation dominated by low-growing dense scrub-vegetation of the type formed by heather and ling, sometimes mixed with broom and gorse

As well requiring a number of data sources to define the distribution of lowland heathland, the case study also requires information about protected species associated with the habitat. Using data provided by the British Trust for Ornithology (BTO) and BRC, two lowland heathland species, the Dartford Warbler and the sand lizard were selected, and both of these are internationally protected.

With respect to roads, the OS digital 1:250,000 Strategi data, customised into a geographic reference data set for CIS, provides the percentage cover of 15 separate geographic reference attributes for each 1 km square in Great Britain, including A-roads, B-roads and motorways.

Producing a Baseline Distribution Map of Lowland Heathland in England

Using the CIS *Refine Region* command (Edit Menu) the three "heathland" data sources can be used to produce a baseline map of lowland heathland in England.

The OS topographic data set is used to distinguish between upland and lowland heathland types by defining region that has a mean altitude in the range of 0 to 250m per sq km (Figure 1). Using the NVC and BRC species data, a species richness map can be produced by taking the top 50% of indicator species that had the highest "preference" for lowland heathland communities over all other types of biotope. Because many species can co-exist in comparatively small areas of lowland heathland, areas of high co-occurrence of lowland heathland indicator species can be used to gain a numerical estimate of lowland heathland quality. Therefore, a region with 75% or more of the maximum species richness for lowland heathland vegetation communities can be defined to identify 10 km squares that are under the greatest threat (Figure 2). Using the LCMGB data, a region of dense shrub heath can be defined with a density greater than 5 ha per sq. km, or 5 % (Figure 3).

The three regions can be combined to produce a base map showing the distribution of lowland heathland (Figure 4). Firstly, the altitude and the species richness regions are used to refine a new region of 10 km squares, which represents a species-based habitat distribution. Because this region is constrained by the scale of the available BRC data, it is not possible to estimate the distribution of the heathland habitat within the 10 km squares. Secondly, and in order to refine this distribution, the species-based habitat region is combined with the dense shrub heath region to produce a distribution map of lowland heathland that incorporates measures of both extent and species composition (and therefore habitat "quality").

Figure 4 summarises the distribution of 1 km squares in England that contain both the "dense shrub heath" land cover type and high "lowland heath species richness" and are below the 250m altitudinal threshold.

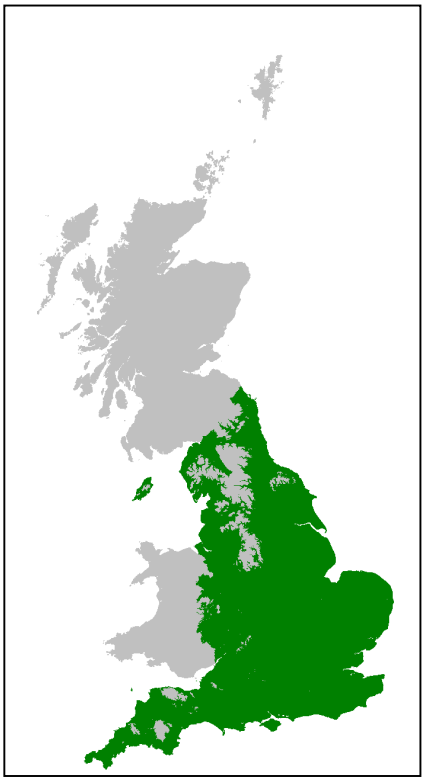

Figure 1. Mean altitude below 250 metres.

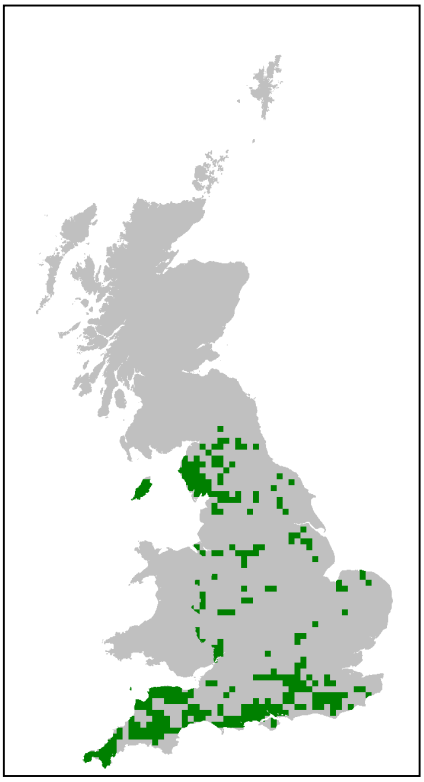

Figure 2. Maximum lowland heath species richness (≥75%).

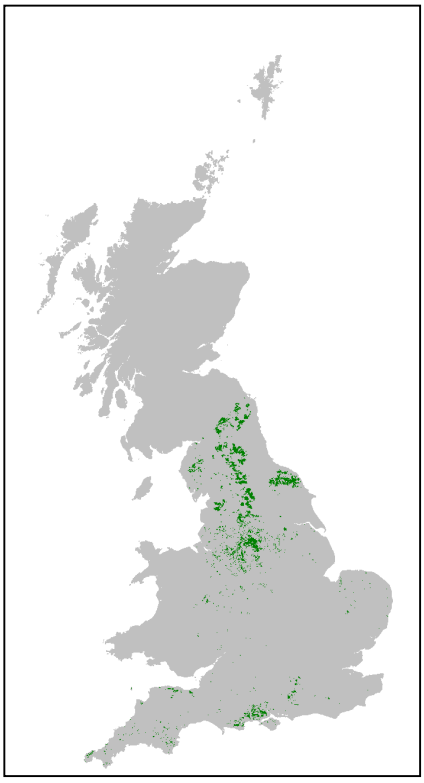

Figure 3. Distribution of dense shrub heath cover type.

Figure 4. Distribution of lowland heathland in England.

Producing a map of the existing road network

To assess the potential widespread or cumulative impacts of road development, a map of the existing road network is required. The OS geographic reference data set provides the density (in ha/sq km) of 15 geographic reference attributes, including motorways, roads and rivers and motorways for each 1 km square in Great Britain. Using the CIS *Refine Region* the data set has been used to produce Figure 5 that shows a "density" map of England's motorway and A-road network.

Producing maps of lowland heathland associated with protected species

As well as demonstrating the use of CIS for assessing the risk to lowland heath habitats, the case study also considers the risks to protected species associated with the habitat. Using the BTO and BRC data, the national distributions of the Dartford Warbler and the sand lizard can be produced (Figures 6 and 7). These maps show the presence (and absence) of the species for each 10 km square of England.

The national distributions of the Dartford Warbler and the sand lizard can be combined with the distribution of lowland heath (Figure 4) using the CIS *Refine Region* command. The resulting map (Figure 8) shows the 1 km squares in which lowland heathland might provide habitat for sand lizards and/or Dartford Warblers.

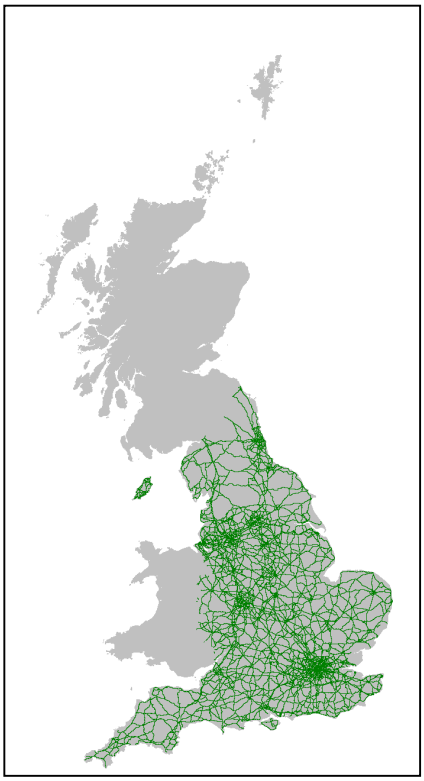

Figure 5. England's Motorway and A-road network.

Figure 6. National distribution of the Dartford Warbler.

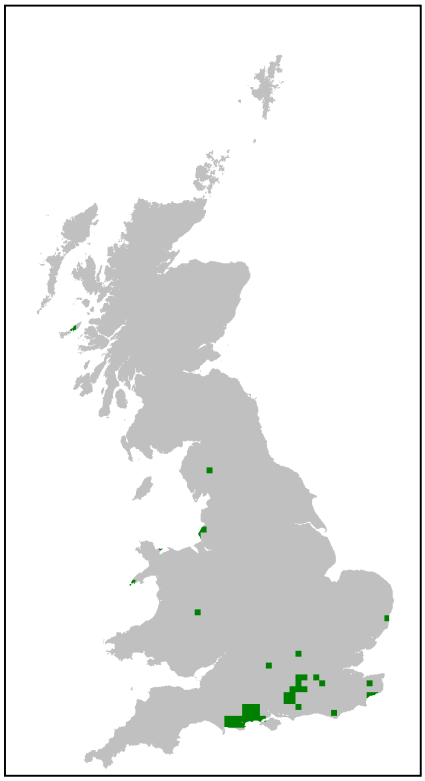

Figure 7. National distribution of the sand lizard.

Figure 8. Co-occurrence of Dartford Warblers and sand lizards with lowland heathland.

Assessing the Potential Ecological Effects of Road Development

The relative proportions of lowland heathland in the English counties are shown in Figure 9. A total of 709 x 1 km squares have lowland heath; 51% of these are in the counties of Hampshire and Dorset.

The map of the motorway and A-road network (Figure 5) can be combined with the lowland heath distribution (Figure 4) using the CIS *Refine Region* command to determine the proportion of England's lowland heathland potentially affected by proximity to motorways and roads under the existing network (Figure 10). Although a relatively crude measure, this can provide an estimate of the proportion of the lowland heathland resource which might already be subjected to the potentially damaging effects of a concentrated road network.

Figure 10 indicates the proportion of lowland heathland squares in the English counties having motorways and major roads. Hampshire and Dorset are clearly identified as the counties with the highest proportion of lowland heathland squares also occupied by motorways and roads.

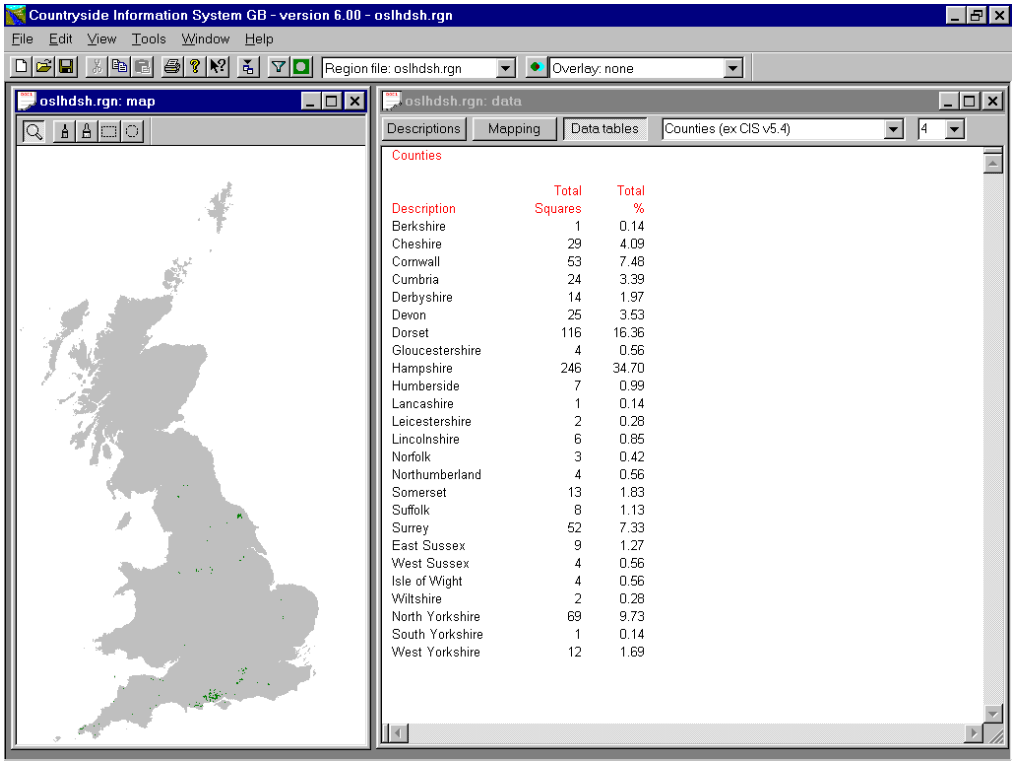

Figure 9. Proportion of “lowland heath” squares by English county.

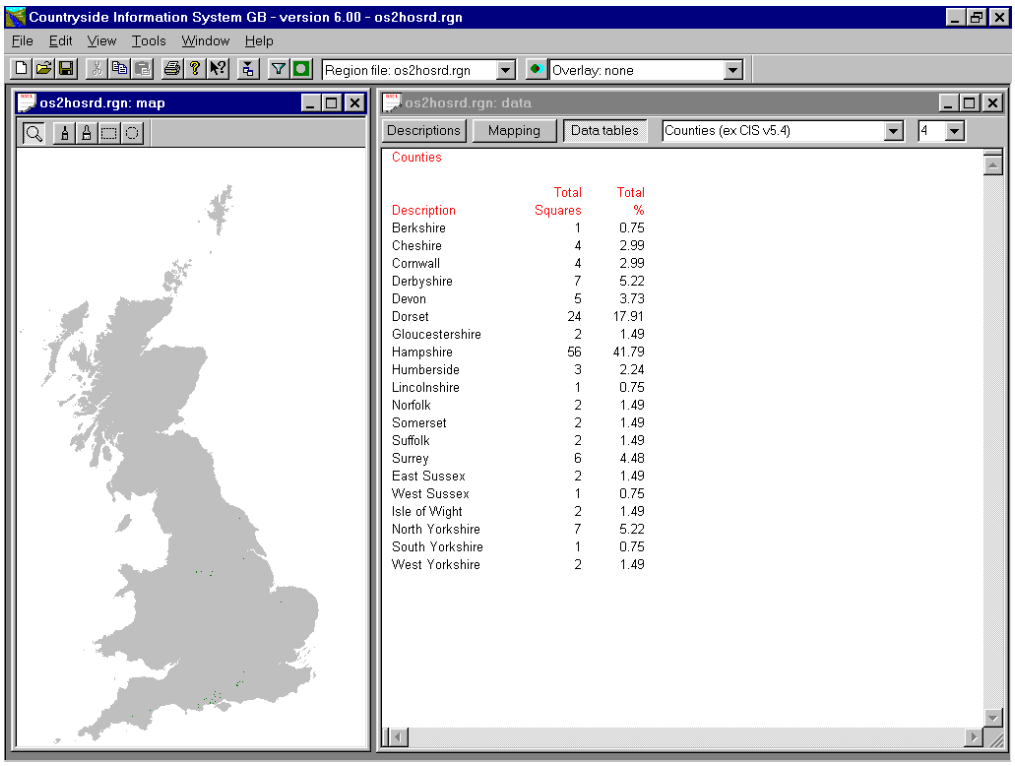

Figure 10. Proportion of “lowland heath and roads” squares by English county.

The map of the motorway and A-road network (Figure 5) can be combined with map of lowland heath that might provide habitat for 2 protected species (Figure 8) using the CIS *Refine Region* command. The resulting map (Figure 11) shows the number of 1 km squares having lowland heathland which coincide with 10 km squares in which sand lizards and Dartford Warblers have been recorded as well as those squares where existing motorways/roads co-occur.

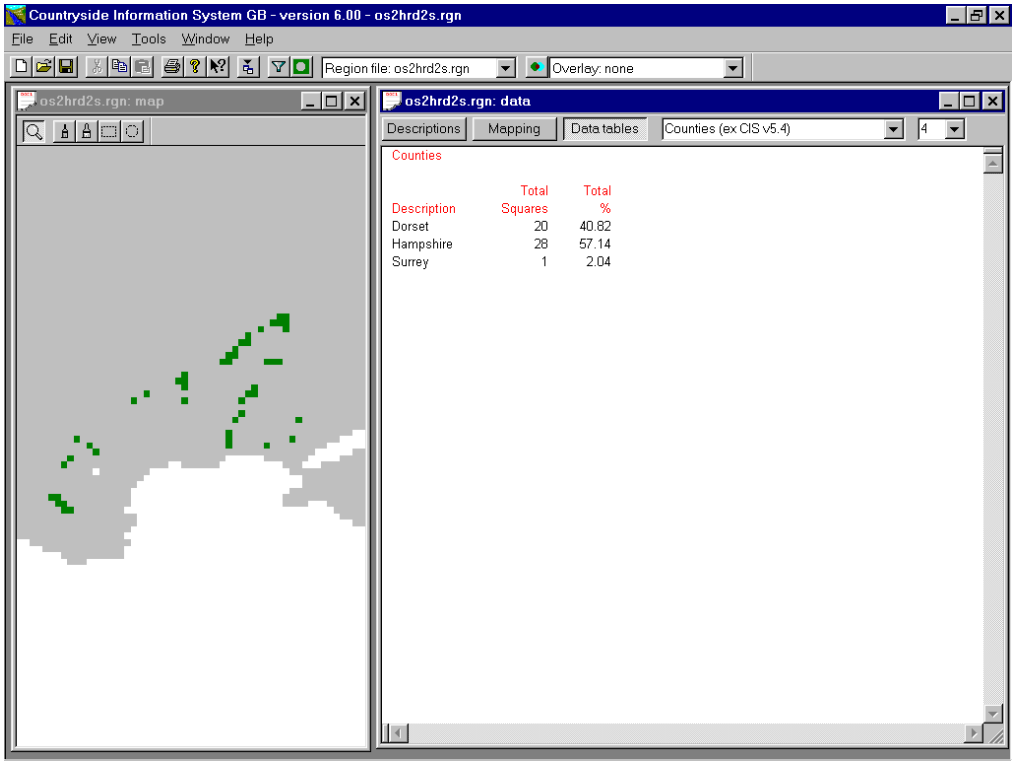

Figure 11. Proportion of "lowland heath, roads and sand lizard/Dartford Warbler" squares by English county.

The only English counties in which lowland heathland co-occurs with records of sand lizards and Dartford Warblers and could currently be influenced by major roads and motorways are Hampshire (28 x km squares), Dorset (20 x km squares) and Surrey (1 x km squares).

The delimitation of these "high value" areas is an important first step in the strategic assessment of possible damage due to road development. As the safeguard of important lowland heathland habitat and its protected species is a priority (under both the European Convention on Biodiversity and the Habitats Directive), any planned national road development strategy should seek to avoid adverse impacts on these areas which might be considered as "potential wildlife hotspots".

Conclusions

The CIS proves to be a very useful tool for the assimilation and analysis of a large number of datasets. The final map of "potential wildlife hotspots" (Figure 11) is based on 7 national datasets and the culmination of 19 "Refine Region" iterations. Although no substitute for the detailed field-survey required for measuring the impacts of road development, the CIS allows rapid assessment in the regional and national context, which are otherwise very difficult to quantify.

Further Reading

Treweek, J.R., Hankard, P., Roy, D.B., Arnold, H. and Thompson, S. (1998). Scope for strategic ecological assessment of trunk-road development in England with respect to potential impacts on lowland heathland, the Dartford Warbler (Sylvia undata) and the sand lizard (Lacerta agilis). Journal of Environmental Management, 53, 147-163.