



Expanding woodlands in Special Protection Areas for golden eagles



Practice Note

Paul Haworth and Alan Fielding

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Golden eagles are primarily birds of open mountain country but they can use open woodland habitats and may benefit from prey species which use woodlands. In 2010 a suite of six new Special Protection Areas (SPAs) covering 360,000 ha were designated by the Scottish Government for the conservation of golden eagles, adding to the existing eight SPA sites in Scotland for this species. Around 28% of the UK golden eagle population lives in these protected areas. This Practice Note reviews the evidence for how golden eagles may be affected by woodland expansion in their breeding territories, and gives interim guidance on how to plan for woodland planting proposals within the protected areas to make them compatible with their golden eagle conservation objectives.

Summary

The Scottish Government has set national targets for woodland expansion. Some proposals have come forward in eagle SPAs and more can be expected. This guidance identifies the criteria and the evidence required to plan and assess woodland expansion proposals in eagle SPAs and suggests practical and cost effective methods of obtaining the information in relation to eagles. Factors include the proposed location of woodland in relation to eagles' nest sites and use of their territory, and the scale, structure and composition of the proposed woodland.

The value and cost of using an existing modelling technique is explored.

Summary guidance on how to assess woodland expansion proposals to meet the requirements of the legislation underpinning the SPA designation is set out in a section at the end of the Note.

This Note has been written by Paul Haworth and Alan Fielding, who have worked extensively on golden eagle ecology. It has been edited and overseen by a steering group comprising staff from Forestry Commission Scotland (FCS), Scottish Natural Heritage (SNH) and Royal Society for the Protection of Birds (RSPB). A draft was also trialled by forestry agents in one of the SPAs. It will be reviewed in the light of further research and experience.

Background

Existing guidance notes on forest design and expansion in relation to golden eagles appear to have worked well over a number of years. These were published by the Forestry Commission based on work with SNH and RSPB:

- the model and guidance in Forestry Commission (FC) Research Information Note 292 (McGrady *et al.* 1997) and
- the subsequent FC Information Note *Golden Eagles and New Native Woodland in Scotland* (McGrady and Petty, 2005).

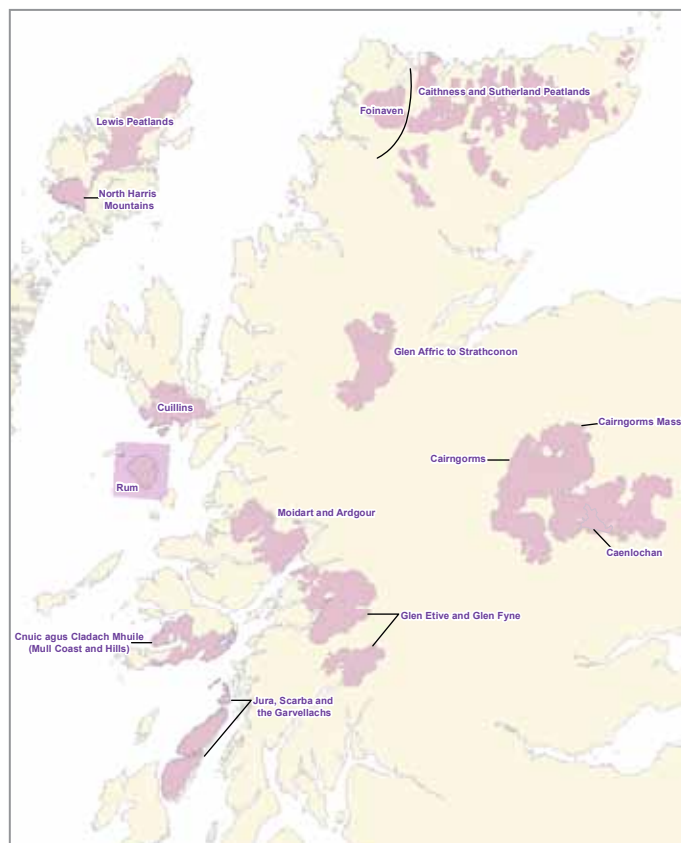
These Notes broadly defined sympathetic management for golden eagles in the absence of more specific local information to the contrary. However, they were aimed at guiding planting proposals throughout the golden eagle range and did not specifically consider woodland expansion within or close to golden eagle SPAs, or the need to comply with the requirements of the [Habitats Regulations](#), which transpose the EU Birds and Habitats and Species Directives.

An initial suite of eight Special Protection Areas were designated for golden eagles and other bird species in the late 1990s. These covered only part of the species' overall distribution in Scotland and so in 2010, the Scottish Government confirmed the designation of a suite of six more Special Protection Areas specifically for golden eagles, covering an additional 360 000 ha. Around 28% of the 440 pairs of golden eagles in the UK live in the 14 SPAs.

Forestry Commission Scotland analysis has shown that woodland cover ranges from less than 1% to 11% of the area of the newly designated SPAs. This current scale and type of forest is unlikely to be problematic for golden eagles since these sites were selected as the best territories with this woodland already present. In the existing woodlands within SPAs, ongoing management is unlikely to be restricted, but targeted management in some golden eagle ranges could benefit eagles.

Woodland expansion may result in beneficial, neutral or adverse impacts dependent upon a variety of factors and any proposal will need to be assessed against the conservation objectives for each SPA.

Figure 1 Map showing golden eagle SPAs in Scotland.



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Golden eagles and woodland habitat

It seems reasonable to assume that many current woodland areas within the designated SPAs are capable of some expansion without compromising the golden eagle conservation objectives.

Many designated SPAs in the west of Scotland include long-standing degraded upland landscapes characterised by historic woodland clearance, heavy grazing and repeated burning leading to low biodiversity (Darling 1955).

The key issue for eagles regarding woodland expansion is the potential loss of habitat and any subsequent reduction in prey abundance and availability in relation to successful breeding.

Mountain hares and grouse form a large part of golden eagle diet in the east of Scotland (Watson, 2010). However, there is little evidence that golden eagles, at least in the west of Scotland, are specialists in terms of diet (Whitfield *et al.* 2009), and certainly in the west of Scotland they will take any live prey that is available (Haworth *et al.* 2009).

An adequate number of nest sites are clearly available for all pairs of eagles to breed within the SPAs. Food demands for golden eagles outwith the breeding season are likely to be smaller than when adults also have young to feed and thus unlikely to be compromised by modest woodland expansion.

Although a detailed review is beyond the scope of this document, it is clear that some golden eagles can maintain or enhance breeding productivity in conjunction with both planting and natural regeneration of native woodlands. On the Isle of Mull the removal of sheep has had little measurable impact on golden eagle productivity. At one range sheep and deer were removed in 1995 to facilitate large scale landscape regeneration. This pair has continued to breed successfully averaging more than one chick per year from 1997 onwards. In the past four years sheep have been reduced to very low numbers across three other ranges in central Mull and in 2008 these three produced five young. At another range in north Mull extensive broadleaf native woodland expansion, covering approximately 400 ha coincided with the pair laying eggs for only the second time in almost thirty years and then breeding successfully in 2007, 2008 and 2010.

There would appear to be no examples so far of any adverse impacts to golden eagles arising from any native woodland expansion by planting and/or natural regeneration anywhere in Scotland.

Much has been made in the past of the potential detrimental effects of loss of carrion as a food resource to golden eagles. Such losses have been inferred when grazing animals are excluded from plantings or areas of natural regeneration. The importance of carrion has almost certainly been overstated and it seems reasonably clear that live prey is the key to eagle breeding productivity (McGrady *et al.* 1997, Watson, 2010, Haworth *et al.* 2009). Most pairs of golden eagles tend to lay eggs each year but only one pair in three is successful in fledging any young. A likely explanation for this is a lack of available live prey.

In recent years substantial reductions in the numbers of hill sheep have had no discernible adverse effect on the productivity of breeding golden eagles over large parts of the west of Scotland (Haworth *et al.* 2009). Relatively modest amounts of carrion are probably sufficient to sustain a pair of golden eagles during winter and few areas with eagles will be completely free of fallen deer and/or sheep.

The benefits of expanding native woodlands for other large raptors such as white-tailed eagles and hen harriers have been described in Evans *et al.* (2010) and Haworth and Fielding (2009).

Most recently SNH have detailed a bold vision for large scale landscape restoration involving the considerable biodiversity benefits of expanding native Scots pine woodland at Glen Feshie, within the Cairngorms Massif SPA (Nelson, 2010).

The potential for woodland expansion in SPAs

There have already been a number of proposals for woodland creation projects within the recently designated golden eagle SPAs, mostly for native woodlands. However, the SPA designation may prevent potential woodland expansion in these areas unless the new woodlands can be shown not to be detrimental to the SPA conservation objectives.

Substantial tracts of land within the SPA boundaries are naturally suited to woodland cover, even allowing for the exclusion of areas of peat greater than 50 cm depth, which are now excluded from planting on policy grounds related to greenhouse gas emissions. The existing guidance detailed in McGrady *et al.* (1997) and McGrady and Petty (2005) is a useful basis and starting point for considering the potential for woodland expansion. All proposals will need to be assessed against the SPA objectives and information relating to the agreed criteria brought up to date.

Potential assessment criteria

This section reviews relevant criteria that need to be considered when anyone is planning potential woodland creation projects in and SPA. It may also be helpful for considering other forestry plans e.g. those involving restructuring of existing forests.

At the end of this Note is summary guidance on how to assess projects to meet the requirements of the Habitats Regulations.

Nest site location(s)

During the breeding season the nest site is the focal point of most golden eagle activity. A recent review by Whitfield *et al.* (2008) indicates that a disturbance-free zone of 1–1.5 km around the nest is appropriate to avoid disturbance to breeding eagles.

In addition, RIN 292 suggested that the core of an eagle range, up to 2–3 km from the nest, should be avoided by woodland expansion projects. This was proposed to protect open foraging habitat within the core range rather than preventing disturbance to active nests.

Some ranges contain several alternate nest sites. It is probably safer to treat each nest site separately rather than use an average location.

SNH hold detailed nest site data for SPAs. At minimum there will be nest site data for 1982, 1992 and 2003.

Topography

Ridges are important topographic features which allow eagles to navigate freely around the range and to transport prey items to the nest. Ridges appear to be important in the delineation of range boundaries and are frequently the focus of display flight activity. Woodland expansion should generally avoid the uppermost part of ridges. Ridge features are easily identified from Ordnance Survey maps and digital elevation data is widely available if required.

Valley bottoms are relatively little used for hunting and so planting in valley bottoms will normally have little or no impact on prey availability (and could add to overall prey populations).

Habitat

Certain habitat types should be avoided by woodland expansion because they already have intrinsic value as potential sources of golden eagle prey. Foremost in this category are mires (largely excluded anyway if they have peat over 50 cm depth).

At the other extreme there is little reason to avoid woodland establishment on areas dominated by bracken which contain limited available eagle prey and would naturally be dominated by native trees. Other habitats normally little used by foraging eagles are short grassland /improved grassland (except near rabbit warrens), arable land, urban areas and water bodies.

Modification or loss of these less favoured habitat types is unlikely to lead to a net reduction of golden eagle prey in most cases as prey production exported from the woodland is likely to offset or exceed any losses.

In addition to field surveys, SNH hold various forms of relevant land cover data such as LCS88 and LCM 2000. Up to date aerial photographs and satellite images are also often available.

Concentrations of eagle prey

Concentrations of golden eagle prey are unusual and mainly restricted to rabbit warrens and sea bird colonies. Some ranges may contain important numbers of breeding waders such as golden plover. Field survey will be required to determine the location and extent of any rabbit warrens and the numbers and distribution of breeding waders. It is important that any existing rabbit warrens are not affected by woodland expansion. This has implications for rabbit control prior to any planting.

Overall, the aim should be to ensure that all woodland creation takes full account of all existing golden eagle prey resources.

The end result for the golden eagle population within the SPA in terms of prey availability should be maintenance, or preferably improvement, compared with the position prior to planting, or to the situation which would have happened if woodland expansion had not occurred. In addition the transitional period, before the benefits of woodland expansion are realised, should not be detrimental to golden eagle prey availability for a sustained period.

Scale and type of woodland expansion

The scale and type of woodland expansion are likely to be key features influencing the need for and detail involved in any assessment.

Watson *et al.* (1987) suggested that eagles might cease to breed if more than 40% of their range at preferred altitudes within 4 km of the nest was planted up. However, such predictions turned out to be much more complex. For example, Whitfield *et al.* (2007) concluded that some golden eagle ranges could be abandoned if only 5% of the range was planted with forestry. However this example applied to conifer plantations and to a

subset of golden eagle ranges which had low productivity and were heavily constrained by other neighbouring eagles.

Native woodland creation grant schemes will normally include about 25% of open ground, whilst most other types of woodland creation schemes have about 10% open ground. The scale and layout of any proposal, particularly the extent and configuration of open ground, will be key features in any assessment.

Proposals for planting or regenerating any woodland are likely to require a detailed assessment on a case by case basis at the scale of the individual golden eagle range within each SPA.

Predicting range use: the PAT model

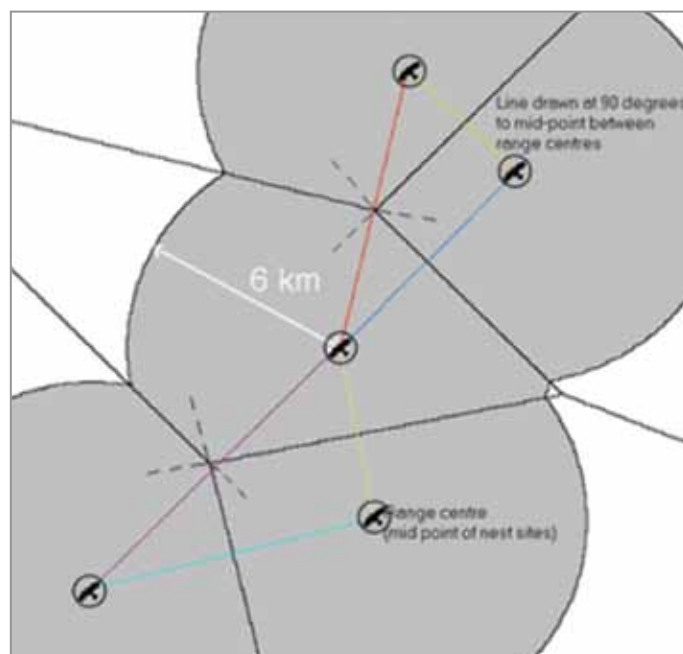
Since the development of the model in RIN 292, attempts have been made to improve our understanding of golden eagle range use. For example the incorporation of eagle flight behaviour in order to predict the varying intensity of use by golden eagles of their range (McLeod *et al.* 2007 and Fielding *et al.* 2003). The PAT (Predicting Aquila Territories) model was developed as a refinement of the model in RIN 292. Use of the PAT model is now normally required by SNH where windfarm developments potentially impacting golden eagles are involved (SNH, 2005).

If there are no neighbours, a 6 km cut-off from the range centre is used as the notional range boundary. Within the notional territory a 'core area', within which 50% of eagle activity occurs, is further delimited by a circle of 2-3 km radius. If there are neighbours, between-range boundaries are modelled by Thiessen polygons (Figure 2). Any area within a Thiessen polygon is closer to the point on which the polygon is centred than it is to any other centre point in the dataset.

Enhancing the RIN 292 model

The PAT model (McLeod *et al.* 2007 and Fielding *et al.* 2003) begins with the RIN's Thiessen polygons but incorporates a combination of excluded areas and categorised variables. For example, golden eagles are sensitive to human disturbance and tend to avoid areas such as settlements and roads. This is modelled by using disturbance distances or buffer zones around human settlements. Water bodies and the sea are treated as exclusion areas because they provide few air currents that golden eagles can exploit, and they provide few prey sources. However, it is recognised that eagles do take wildfowl and seabirds (Haworth *et al.* 2009). The PAT model assumed that golden eagles avoid all woodlands once the trees reach 12-years-old as eagles are unable to access the open ground between trees. This means the PAT model may underestimate the actual use made of wide spaced older native woodlands by golden eagles.

Figure 2 Territory boundary allocations using Thiessen polygons.



Eagle behaviour

Breeding behaviour is included in the PAT via two mechanisms. First, because breeding birds are central place foragers and they should spend most time close to the nest (modelled as the range centre). Earlier modelling, and empirical data, confirmed that eagles tended to use central parts of their home range most frequently, and that this feature is incorporated into the PAT by weighting predicted range use towards the range centre. In addition, in a species such as the golden eagle, that is adapted for soaring flight, it is likely that terrain features will affect range use. In the cool Scottish climate thermal air currents are rare but wind deflected upwards off terrain features is probably an important aid for flight. Chalmers (1997) found a strong relationship between eagle activity and ridge features, which is consistent with the use of deflected wind currents on slopes.

Terrain recognition

In order to incorporate terrain features into the PAT an automated recognition method, using digital elevation data (DEM), was developed and applied to every pixel within the predicted range limits. In a raster DEM each pixel has an elevation value that can be compared with its neighbours and, by using a set of rules, its terrain type can be identified automatically. Proximity to certain terrain features and the range centre is used to estimate the relative importance of each pixel within the range boundary. The output of the PAT model is a raster representation of predicted range use: each 50 x 50 m pixel having a predicted 'use value' constrained so that they sum to 100. Pixels with higher use values are located near the

range centre and around useful terrain features, and pixels with the lowest values are further away from the centre and terrain features. A 'use surface' is generated such that pixels, predicted as being used, are ordered in decreasing use value and then sequentially summed. Isolines are then fitted to this surface, encompassing notional percentages of predicted ranging. For example, the 95% isoline encompasses the 95% highest use value pixels, and represents the geographic area required to encompass 95% of a pair's predicted ranging.

Box 1 – Summary of the PAT model.

- Golden eagle ranges can be approximated by Thiessen polygons with a 6 km cut-off.
- Golden eagles are more likely to use habitat close to the range centre and close to a ridge.
- They are unlikely to use some habitats (water, closed canopy woodland, arable, improved grassland, urban etc.).
- These features were combined to produce an 'expected use' for each 50 m pixel within an eagle's range.
- More comprehensive descriptions of the PAT model can be found in McLeod *et al.* (2002) and Fielding *et al.* (2003).

Using the PAT to model the impacts of woodland expansion

Outline

The predicted range loss resulting from a woodland proposal is the sum of 'use values' for pixels covered by the proposal. However, account must be taken of the type of woodland proposal, particularly the extent of open ground and the potential for prey to be locally enhanced by the new woodland area.

Example Range Loss Calculation

The total area of woodland enclosure proposed for a golden eagle range is approximately 372 hectares, comprising existing native woodland, some new native broadleaf woodland planting and extensive, inter-connected open ground. The PAT model was used to predict the range loss to the resident golden eagles using the 2008 nest site as the range centre (Figure 3).

Because pixels can have different predicted 'use values' the loss of some pixels will be more detrimental than the loss of

others. This is taken into account by calculating a weighted range loss.

The potential loss of predicted range use was obtained by overlaying the predicted use model with the proposed planting scheme and then summing the weighted (area by use) and unweighted (simple area) losses (Table 1).

Table 1 Predicted losses (percentage of cumulative area) to the PAT model from the proposed planting scheme.

PAT Area	Unweighted	Weighted
50% PAT	0.70%	0.20%
90% PAT	7.30%	3.50%
95% PAT	8.10%	3.80%
100% PAT	8.20%	4.30%

Very little of the core of the range (the 50% PAT model) is predicted to be lost (0.2% weighted use and 0.7% simple area) and only 3.8% of the use-weighted 95% PAT model area is predicted to be lost. These are relatively small areas and, because it is unlikely that the birds would be completely excluded from the new native woodland, they are very conservative loss estimates.

Much of the land proposed for broadleaf tree planting in this example is currently infested by dense stands of bracken and such areas are not thought to be especially important for sustaining raptor prey. In addition, any prey within deep bracken is unlikely to be available for capture.

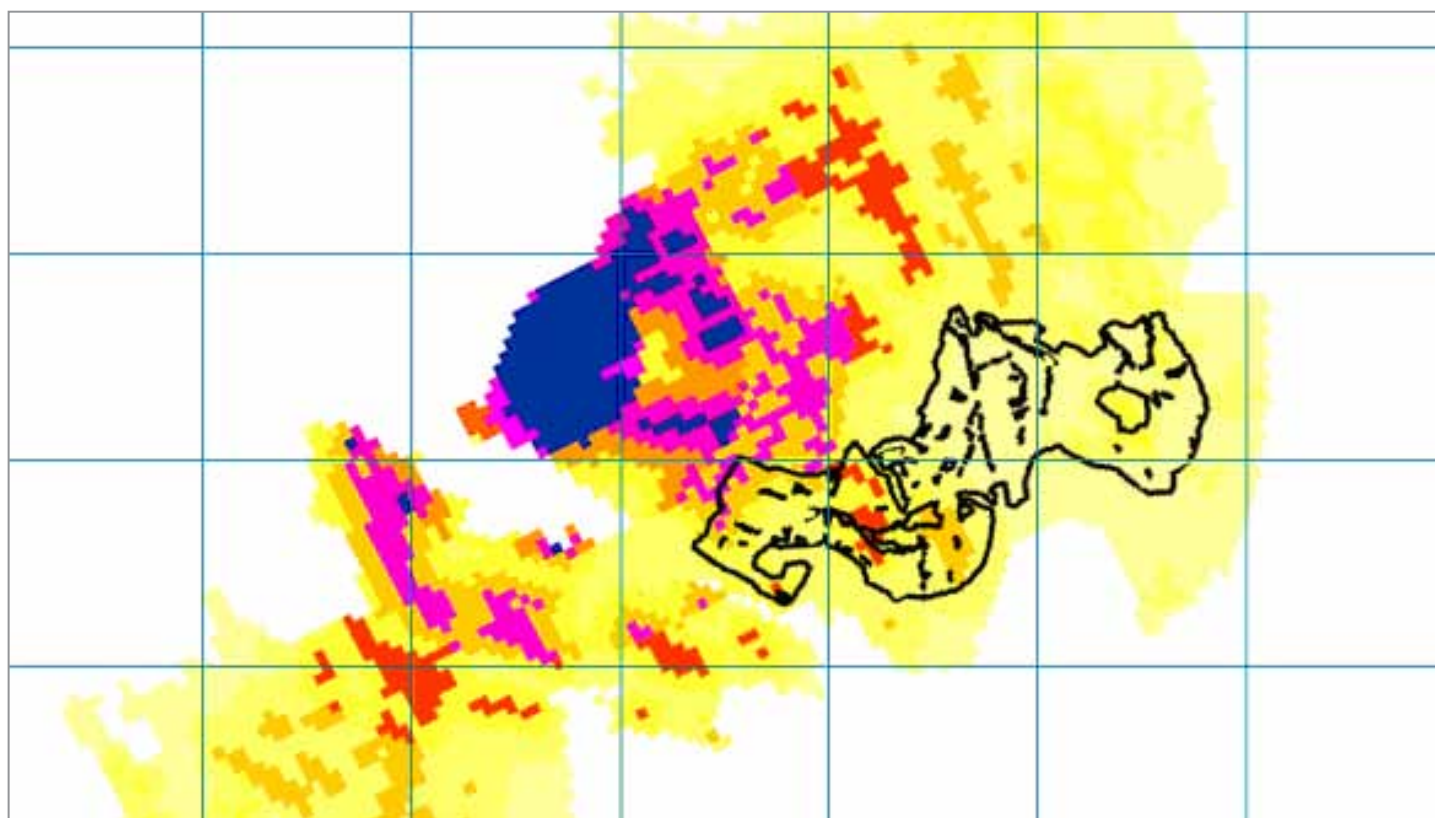
This worst case scenario described in the above example is very unlikely to transpire. Much of the native woodland new planting will remain as open ground. This area of open ground will be approximately 41 ha in extent and is in addition to the 32 ha of other open land and 49 ha of ground left unplanted to safeguard archaeological interests.

Open ground at this scale is likely to prove attractive to foraging golden eagles providing that live prey, particularly mountain hares are available. In the absence of large herbivores such as sheep and deer the abundance of hares and small mammals will increase (Evans *et al.* 2006).

Costs of utilising the PAT model

The production and interpretation of the PAT model is currently available from a very limited number of specialist consultancy firms. SNH or FCS can advise on how to go about commissioning use of the PAT model.

Figure 3 PAT model overlaid with the proposed planting scheme. The colour intensity indicates the predicted use by the territorial birds. The grid is 1 km and the background is a topographic map using SRTM digital elevation data (Shuttle Radar Topography Mission, Global Land Cover Facility, www.landcover.org).



The vast majority of PAT modelling applications have been undertaken with regard to proposed windfarm developments and in 2012 they typically cost up to £1,500 per proposal. Such costs could perhaps be absorbed by individual large scale woodland proposals and in some cases PAT modelling will form an essential element of impact assessment in relation to breeding golden eagles and woodland expansion. The mapped output from such PAT modelling would also serve to highlight areas of an eagle range where forms of land use change and/or development might be considered appropriate.

However for smaller scale woodland expansion involving planting and/or regeneration the costs of PAT utilisation are likely to deter many potential applications, especially if the outcome is highly uncertain. A certain degree of flexibility is clearly required in deciding where the PAT modelling exercise is appropriate.

A potential way forward which is currently being explored by SNH and FCS would be to run the PAT for some or all the ranges within a particular SPA and then reach agreement on the nature and scale of the potential for woodland expansion on a range by range basis. Areas of the eagle range that should clearly be avoided could also be identified at this stage as constraint maps. This would avoid many repeat runs of the modelling exercise for an agreed period, of say five years. Such

constraint maps would only need to be updated if the status of the local eagles changed, for example: a new nest site is used, a neighbouring pair is lost or a new pair establish. All three of these scenarios change the size and shape of the Thiessen polygon used in the PAT modelling.

At the scale of the individual range the application of agreed criteria could usefully identify areas where woodland expansion could be considered to be potentially beneficial habitat management, for example, an area dominated with bracken with no rabbit warrens and at a considerable distance from golden eagle nest sites. Proposals in such areas would generally be viewed in an entirely positive light.

This approach has been developed in the Glen Etive and Glen Fyne SPA, where a series of [range reports](#) have been produced.

Where proposed woodland expansion is considered to lack clear direct benefits to eagles, then each proposal will need to be considered on a case by case basis at the scale of the relevant golden eagle range.

At a more strategic scale it may be possible to scope all golden eagle SPAs with a view to identifying a small sub set of designated areas which are a priority in terms of running the PAT model.

Conclusions

Available evidence suggests that native woodland expansion, given appropriate design, layout and limits, will not adversely affect golden eagle populations and may, over time, be beneficial by improving the live prey base for the eagles.

Evidence also suggests that proposals for densely stocked productive woodlands within golden eagle SPAs present greater challenges than native woodland expansion in terms of likely effects on the available golden eagle prey base.

The review described in this Note made a number of recommendations for further work which are being considered and taken forward by a Golden Eagles and Forestry Working Group. These proposals include:

- Further guidance on what scale and type of woodland expansion proposal will require a PAT modelling exercise to be undertaken, together with worked case study examples.
- Consider the value of a strategic assessment of potential woodland expansion on a range by range basis for one or more designated SPAs.
- Guidance on possible mitigation measures to be applied in association with any proposal for woodland expansion in golden eagle SPAs.
- A review of evidence on relationships between recent woodland expansion and breeding success of golden eagles, with case studies, to provide up to date information on any impacts. The existing FC Guidance Notes on golden eagles should then be updated.

Summary guidance on how to assess potential woodland expansion schemes in terms of the Habitats Regulations is set out in the section below.

Box 2 – Summary guidance on assessing woodland expansion proposals in relation to the requirements of golden eagle SPAs.

This section outlines the requirements for assessments of potential impacts of woodland proposals on golden eagle SPAs. It is put forward as **interim summary guidance** for those considering woodland expansion projects that might affect these sites. Users can find more detailed advice and background in the rest of this Practice Note.

FCS expects that a revised version will be developed in the light of experience and feedback from forestry agents, SNH and FCS.

European sites

The status of a Special Protection Area (SPA) under the EC Directive 79/409/EEC on the Conservation of Wild Birds (the 'Birds Directive'), means that the Conservation (Natural Habitats, &c.) Regulations 1994 as amended; (the 'Habitats Regulations') apply.

Any plan or project which has the potential to affect a Natura site, no matter how far away from that site, should be considered in order to determine whether an appropriate assessment is required. Further detailed guidance is provided by SNH (2010) and should be consulted especially with regard to the three steps under regulation 48.

What is appropriate assessment?

The **Habitats Regulations** require competent authorities to undertake appropriate assessments in certain circumstances

where a plan or project affects a **Natura** (European) site. **Habitats Regulations Appraisal** (HRA) refers to the whole process, including the **appropriate assessment** step. Appropriate assessment is required whenever a plan or project affecting a Natura site is not connected with management of the site for nature conservation, and is likely to have a significant effect on the site (either alone or in combination with other plans or projects).

This applies to any plan or project which has the potential to affect a Natura site. An appropriate assessment should focus exclusively on the **qualifying interests** of the Natura site affected and must consider any impacts on the **conservation objectives** of the site.

The need for appropriate assessment extends to plans or projects outwith the boundary of the site in order to determine their implications for the interest protected within the site.

The Habitats Regulations Appraisal

The Forestry Commission Scotland, as the competent authority, has a duty to:

- a. Determine whether the proposal is directly connected with or necessary to site management for conservation; and, if not,

- b. Determine whether the proposal is likely to have a significant effect on the site either individually or in combination with other plans or projects; and, if so, then
- c. Make an appropriate assessment of the implications (of the proposal) for the site in view of that site’s conservation objectives.

In summary, proposals for woodland expansion will need to take account of the standard conservation objectives listed for the SPAs designated for their golden eagle interest. These objectives aim to avoid deterioration of the habitats of the qualifying species or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained. To be consistent with the conservation objectives, proposals will need to meet the following tests:

- **Population of the species as a viable component of the site:** no adverse impacts on the number of breeding pairs of golden eagles stated in the citation for the particular SPA.
- **Distribution of the species within the site:** no adverse impacts on any of the known golden eagle nest sites.
- **Distribution and extent of habitats supporting the species:** no adverse impacts on habitats favoured by golden eagles in terms of foraging, roosting and breeding.
- **Structure, function and supporting processes of habitats supporting the species:** no adverse impacts on habitats and associated prey populations favoured by golden eagles.
- **No significant disturbance of the species:** no adverse impacts on golden eagles in terms of potential displacement or reduced breeding success arising from establishment and management of the proposal.

- d. In carrying out the above steps the Forestry Commission Scotland shall consult with Scottish Natural Heritage and have regard to its representations.

The competent authority can only agree to the proposal under Regulation 48 after having ascertained that it will not adversely affect the integrity of the site. If this is not the case, and there are no alternative solutions, the proposal can only be allowed to proceed if there are imperative reasons of overriding public interest for the proposal to be consented.

In order for Forestry Commission Scotland to carry out the Habitats Regulations Appraisal it is important that the applicant submits the necessary information as part of their proposal for woodland expansion.

Suggested information requirements

Is the proposal within a SPA?

The SPA boundary will be on maps provided by SNH.

Is the proposal for planting or regeneration or a combination of the two? Is the proposal for native species? What is the scale of the proposal? What is the extent and configuration of open ground?

A full description and maps will need to be provided by the applicant.

What are the distances to any golden eagle nest site(s)?

Some ranges contain several alternate nest sites. It is probably safer to treat each nest site separately rather than use an average location. SNH hold detailed nest site data for SPAs. At minimum there will be nest site data for 1982, 1992 and 2003.

Figure 4 Eagle pellets.



What is the type and extent of habitat(s) proposed for conversion to woodland?

Certain habitat types should be avoided by woodland expansion because they already have intrinsic value as potential sources of golden eagle prey. Mires with at least 50cm of peat are already ruled out for any woodland expansion under an interim FCS policy relating to greenhouse gas balance. At the other extreme there is little reason to avoid woodland establishment on areas dominated by bracken which contain limited available eagle prey and would naturally be dominated by native trees. Further guidance on habitat preferences is provided in RIN 292 (McGrady *et al.* 1997).

Planting that focuses on less favoured habitats and topography may have neutral or positive effects on the supply of available prey (but see below on concentrations of rabbits or bird populations). Conversion to woodland, particularly native broadleaved woodland, of habitats dominated by bracken, *Molina* and *Nardus* is unlikely to have significant effects and should pass the first stage of the Habitats Regulations Appraisal (see Potential assessment criteria section, page 4), provided it is a sufficient distance from eagle nest sites to avoid disturbance and other effects.

In addition to field surveys, SNH hold various forms of relevant land cover data such as LCS88 and LCM 2000. Up to date aerial photographs and satellite images are also often available. FCS holds information on existing woodland areas, available to view through the FCS Map viewer facility on the FCS website. Data for GIS analyses may also be made available by arrangement.

What surveys for mammals (e.g. rabbits) and birds (e.g. waders) have been undertaken?

Concentrations of golden eagle prey are unusual and mainly restricted to rabbit warrens and sea bird colonies. Some ranges may contain important numbers of breeding waders such as golden plover. Field survey will be required to determine the location and extent of any rabbit warrens and the numbers and distribution of breeding waders. It is important that any existing rabbit warrens are not affected by woodland expansion.

It will be important to check the proposed planting area for signs of use by golden eagle. Craggs, particularly those with individual trees or small clumps of trees can be favoured roost sites. These should all be examined for the presence of pellets, droppings and/or feathers. Prominent knolls should be checked in the same way for feathers and pellets. This information will supplement prey surveys and to some degree validate the PAT predictions (see below). Detailed design to avoid or minimise impacts on such features can be treated as mitigation and taken into account in the appropriate assessment (see below). In the majority of cases this walkover validation exercise will require no more than one day of field survey.

Does the proposal avoid topographic features such as ridges?

Ridges appear to be important in the delineation of range boundaries and are frequently the focus of display flight activity. Woodland expansion should generally avoid the uppermost part of ridges. Ridge features are easily identified from OS maps and digital elevation data is widely available if required.

Figure 5 Eagle feather on crag.



What is the current extent of tree cover in each golden eagle range?

This could be estimated from maps where tree cover at the scale of the range is sparse, say less than 2%, but will need to be calculated more precisely where existing woodlands are already widespread. All estimates and/or calculations will need to take full account of open ground within existing woodlands.

What is the percentage of woodland cover within the golden eagle range assuming the proposed expansion proceeds?

This figure will need to be presented as part of any proposal. Available evidence suggests that native woodland expansion, given appropriate design, layout and limits, will not adversely affect golden eagle populations and may, over time, be beneficial by improving the live prey base for the eagles. In general woodland expansion will be favoured in areas distant from known golden eagle nests.

Use of the PAT model, in conjunction with prey and habitat surveys, will be helpful in determining if the location of potential woodland expansion coincides with areas predicted to be favoured by foraging golden eagles.

What mitigation measures are proposed to minimise any predicted impacts?

For example, consider detailed design, stocking density, planting method, and timing of operations. These may be taken into account for appropriate assessment in determining the net implications for an SPA of a complete proposal.

What other plans or projects are proposed that might also have a significant effect in combination with the proposal?

For example, consider the likely implications of any other woodland creation proposals that are already approved.

Useful sources of information

Forestry Commission publications

Golden eagles and forestry.

Forestry Commission Research Information Note, 292, 1997.

Golden eagles and new native woodland in Scotland.

Forestry Commission Information Note, 2005.

The Scottish Government's rationale for woodland expansion.

Forestry Commission Scotland, 2009.

Other publications

CHALMERS, S. (1997). *Detection and characterization of terrain features for incorporation in Golden Eagle (Aquila chrysaetos) territory models*. M.Sc. thesis. University Edinburgh, Edinburgh, Scotland.

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Enquiries relating to this publication should be addressed to:

Forestry Commission Scotland
231 Corstorphine Road
Edinburgh
EH12 7AT
Telephone: 0131 334 0303

gordon.patterson@forestry.gsi.gov.uk
www.forestry.gov.uk/scotland

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