- *Hen Harriers* (Circus cyaneus) *are a protected bird species under European law, and one of the birds of greatest conservation concern in Ireland.*
- *In forested areas Hen Harriers nest and forage in young plantations, but closed canopy forests are generally not used by this species. The suitability of Irish plantation forests for Hen Harriers therefore depends on their age structure.*
- *Nine Indicative Areas for Hen Harriers (IAs) have been outlined. In order to ensure that these areas remain suitable for Hen Harriers, land use policy and practice within them need to be informed by the habitat requirements of this species.*
- *The proportion of land in the IAs that is unsuitable for Hen Harriers (i.e. mature forest and improved grassland) will increase from about 30% (at the time of the Hen Harrier survey in 2002) to about 50% by 2015.*
- *When assessing the impact of proposed land use changes such as afforestation and agricultural intensification, changes in the value to Hen Harriers of habitats in the affected area and in the surrounding landscape should be taken into account; especially in areas with high levels of forest cover.*

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The distribution of Hen Harriers in Ireland in relation to land use cover, particularly forest cover

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Introduction

Hen Harriers, *Circus cyaneus*, were once widespread in Ireland, but have declined in range and population over the past 200 years, through a combination of habitat loss/degradation and persecution (O'Flynn 1983, Whilde 1993). This decline was reversed between 1950 and 1970, when many upland areas were planted with coniferous forest (O'Flynn 1983). Although the traditional breeding habitat of Hen Harriers in Ireland and Britain is open moorland (Gibbons et al. 1993), the ground vegetation of young plantation forests can be more suitable for Hen Harrier nesting and foraging than that of surrounding open habitats, where heather and long grass cover can be limited by heavy grazing or burning (Madders 2003). Hen Harriers in Ireland used newly established conifer plantations for both hunting and nesting, and reached an estimated peak of between 200 and 300 pairs (Watson 1977).

However, since 1970, the Hen Harrier population in Ireland has undergone a rapid decline (Newton et al. 1999, Whilde 1993), and more recent estimates have

Photo: Marc Plomp www.natuurdigitaal.nl

Male Hen Harrier.

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placed the breeding population at 120-140 pairs (Gibbons et al. 1993, Norriss et al. 2002). This decline has been attributed to agricultural improvement of marginal rough pasture, bogland and scrub, and to the maturation of the Irish forest plantation estate (O'Flynn 1983, Whilde 1993). Hen Harriers cease to use plantations after canopy closure and, until recently, evidence has suggested that Hen Harriers make little use of young second rotation forests either for nesting or for hunting (Madders 2000, Petty and Anderson 1986). A survey of Hen Harriers conducted from 1998-1999 found that, in some parts of Ireland, nests were often located in young second rotation conifer forest (Norriss et al. 2002). However, in areas such as Wicklow, where there is now little afforestation, Hen Harriers have disappeared, despite wide availability of young second rotation forests (Gibbons et al. 1993, Norriss et al. 2002). Reforested sites may be less suitable for foraging than young new plantations due to the presence of brash and a lower cover of ground vegetation (Madders 2000, Norriss et al. 2002). Moreover, forest areas generally have a closed canopy for about two thirds of the forest cycle. This means that even if pre-thicket first and second rotation forests are as valuable to Hen Harriers as the pre-planting open habitats they replace, afforestation will still result in a net loss of habitat to Hen Harriers (Bibby and Etheridge 1993).

In May 2002, nine Indicative Areas (IAs) ranging from 61 to 744 km^2 were identified by the National Parks and Wildlife Service (NPWS) as holding >1% of the all-Ireland breeding population. Recommendations for a suite of Special Protection Areas (SPAs) for breeding Hen Harriers, under European Council Directive 79/409/EEC on the conservation of wild birds, have still to be finalised. All of these areas have relatively high levels of forest cover, and stakeholders in these areas are anxious to allow further afforestation. While it is likely that Hen Harriers will require substantial areas of open habitats if they are to persist in afforested landscapes, the size of such areas has not yet been objectively determined. There is, therefore, a pressing need for information on the habitat requirements of Hen Harriers. If the activities of the farming community and other stakeholders are to be curtailed in Hen Harrier SPAs, it would be preferable to have a clear idea of the impact that these activities would have been likely to have. Furthermore, even if no further afforestation is sanctioned in these areas, their value to Hen Harriers is likely to change. The high level of forest cover in the SPAs means that their suitability for Hen Harriers is likely to be affected by the relative proportions of open and closed canopy forest within them. It is possible that in some places, Hen Harriers could benefit from further tree planting if, at some stage in the future, this would provide them with areas in which to hunt or nest at a time when these activities were not well catered for by non-forest habitats.

Hen Harrier Indicative Areas (IAs)
Source: NPWS 2003.

The aims of this study were:

1. to determine whether areas within the IAs with breeding Hen Harriers could be distinguished from areas where they did not occur, using a threshold level of habitat cover suitable for Hen Harrier hunting and nesting and
2. to predict how changes in age structure of the forests within the IAs will affect the suitability of IAs for Hen Harriers by 2015.

Hen Harrier distribution data were taken from:

- The nationwide survey co-ordinated by Dúchas, Birdwatch Ireland, and the Irish Raptor Study Group (Norriss et al. 2002). A concerted effort was made during this survey to census all Hen Harriers breeding in Ireland, covering all areas where they have been known to occur, and a selection of other areas that contain potential breeding habitat. Survey effort was concentrated on obtaining evidence of breeding, so any pairs for which there was no definite or probable evidence of breeding were excluded from analyses. The position of most breeding pairs found during the survey was estimated to an accuracy of 100 m; the remainder

of records were accurate to within 1 km. Most of these data were gathered between 1998 and 2000, but they were supplemented by data collected in 2001-2003. This survey shall henceforth be referred to as the 1998-2003 survey.

- The other datasets analysed were those collected during the surveys for *The Atlas of Breeding Birds in Britain and Ireland* (Sharrock 1976), henceforth referred to as the Old Atlas survey, and *The New Atlas of Breeding Birds in Britain and Ireland: 1988-91* (Gibbons et al. 1993), henceforth referred to as the New Atlas survey. Data from the Old Atlas survey referred to 10 km squares, while data from the New Atlas survey referred to 2 km squares (henceforth referred to as 'tetrads'). The highest resolution at which data from both surveys could be analysed was the 10 km square - 100 km^2). In each 10 km square surveyed in both Old and New Atlas surveys, Hen Harriers were recorded as either present or absent.

The two sources of data for forest cover were the Forest Inventory and Planning System (FIPS), a geo-referenced database compiled by the Forest Service that covers all forest stands present in Ireland in 1997, and allocates them to forest type and age categories and the Coillte inventory, which contains more detail about each stand (e.g. planting and projected felling years), for forests managed by Coillte.

Hen Harriers and agriculture

The change we found in Hen Harrier distribution over the past 40 years indicate that the species has moved away from lowland areas, where disturbance has increased and agricultural intensification has reduced the availability of Hen Harrier habitat, into areas at higher elevation, where new plantations have provided an abundance of suitable habitat. A similar pattern is apparent in the Hen Harrier's current distribution within the IAs, where they appear to strongly avoid dry grassland and areas at low elevations, both of which are closely associated with improved agricultural land. These variables are not independent of one another; dry grassland cover dominating at low altitudes, but giving way in upland areas to bog and forest habitats. A possible reason for the relatively low cover of dry grassland around Hen Harrier nest sites would therefore have been that Hen Harriers were selecting for vegetation types associated with higher elevations, rather than avoiding land that had been improved for agriculture. However, in three different elevation categories, percentage dry grassland cover around Hen Harrier nests was significantly lower than expected by random chance. This indicates that the Hen Harriers avoid dry grassland at a range of altitudes. Agricultural intensification therefore has the potential to reduce the carrying capacity of land for Hen Harriers at high as well as low elevations.

Photo: Brian McGeough

Hen Harrier female hunting in open habitat.

Photo: Brian McGeough

The 1998-2003 survey targeted areas known to hold extant populations of Hen Harriers, as well as a random selection of areas containing suitable habitat but not known to hold breeding Hen Harriers. Within these areas, surveyors concentrated their time and effort on the habitat that looked best for Hen Harriers (Dúchas 1998-2003 unpublished data). This could have led to a bias in the results of the survey, whereby Hen Harriers occupying habitats perceived to be less favourable for them would be detected less efficiently than Hen Harriers in more traditional habitats. If such a bias were strong enough, it could result in the pattern observed in this study, and the false conclusion that Hen Harriers avoid areas of intense agriculture. However, Norriss et al. (2002) claim the vast majority of Hen Harriers breeding in the Republic of Ireland were detected by the 1998-2003 survey, in which case if such a bias existed, it would apply only to a small number of Hen Harriers. Such a small bias would not be sufficient to generate the relationships between Hen Harrier distribution and habitat described here. Furthermore, all of the improved agricultural land within the IAs is situated within 10 km of areas where Hen Harriers were found during the 1998-2003 survey. Hen Harriers breeding on improved agricultural land in the IAs were therefore more likely to be found than those breeding in similar habitat elsewhere in Ireland. It is therefore likely that agricultural intensification has a real and pronounced negative effect on the value of land to Hen Harriers.

To maintain the populations of Hen Harriers within the IAs at present levels, further agricultural intensification within these areas should be minimised. A recent statement made by Dúchas maintained that existing farming practices are almost certain to be fully compatible with the conservation requirements of Hen Harriers, and that there will consequently be no need to impose restrictions on existing farming activity (Canny 2003). If farming activity is taken to include the ongoing intensification of rough and marginal agricultural habitats, then this assumption may need to be re-examined. The new single premium system, introduced to Ireland in early 2005, will result in a decoupling of stocking from agricultural scheme payments and may result in an increase in the amount of agricultural land that is suitable for Hen Harrier. It will almost certainly lead to an overall decrease in grazing pressure, which might result in the 'roughening' of grassland areas, to the benefit of the Hen Harrier. However, in other areas, small farms may be amalgamated into larger holdings in order to improve their efficiency, accompanied by agricultural intensification.

Photo: Peter Hadfield

Hen Harriers and forestry

The strength of the relationship between Hen Harrier occurrence and pre-thicket forest cover at all levels of post-thicket forest cover indicates that young forests are selected for by the species. The relationship between post-thicket cover and Hen Harrier occurrence, when variation in pre-thicket cover is accounted for, is contrastingly weak, especially when pre-thicket cover is either very high or nearly absent. This is consistent with the conclusion that the positive association between mature forest cover and Hen Harrier occurrence is due in large part to the proximity in the landscape of old and pre-thicket forest. However, post-thicket forest cover is a predictor of Hen Harrier occurrence at low to intermediate levels of pre-thicket forest cover. This may be because, prior to the mid 1990s, new forests were nearly all established in the uplands, typically on unenclosed areas of bog and rough pasture (Fahy and Foley 2002). In contrast, much recent planting has typically taken place on relatively improved agricultural land, in landscapes that are unsuitable for Hen Harrier. Very few areas with Hen Harrier have no young forests at all; and (at least in the IAs) most areas where young forest cover was abundant at the time of the 1998-2001 Hen Harrier survey were probably also suitable for Hen Harriers. However, among areas with low levels of pre-thicket forest cover, upland areas (i.e. those areas containing the majority of good Hen Harrier habitat) are likely to have higher levels of post-thicket forest cover than lowland areas, where agricultural activity is more intensive. This may explain why post-thicket forest cover is positively related to Hen Harrier occupancy at low levels of pre-thicket forest cover.

A limitation of this study is that although we were able to distinguish broadly between habitats that have some value to Hen Harrier and others that do not, it was not possible for us to distinguish low quality habitats (where Hen Harriers forage and nest with relatively little success) from high quality habitats (where Hen Harriers enjoy high levels of hunting and breeding success). This is partly because the resolution of the habitat data we used was quite coarse, but by far the biggest obstacle to determining habitat quality is our lack of knowledge about the value of different habitat types to Hen Harriers. This lack of knowledge is particularly critical in relation to the quality of second rotation forests. While current indications are that young

Maturation of the Irish forest estate will have an impact on the area available as suitable habitat for the Hen Harrier.

Photo: Peter Hadfield

second rotation forests are being used by Hen Harriers for both nesting and foraging, we have insufficient data to judge the value of this habitat in relation to either young first rotation forestry or open habitats such bog and wet grassland. The availability of second rotation forestry will increase greatly over the next few decades, during which time the persistence of Hen Harriers in many heavily forested areas may hinge on the value of young second rotation forestry to this species.

Our estimate of suitable habitat cover in 2015 does not take account of any of the afforestation that will have occurred between 1999 and 2015. Despite the recent move of afforestation in Ireland away from the most marginal lands for agriculture (Fahy and Foley 2002), the majority of land currently put forward by farmers for afforestation is still relatively unproductive from an agricultural perspective, and could potentially be used by Hen Harriers for foraging. Unless financial incentives are put in place to encourage the establishment of new forests on high quality pasture land, it is likely that the majority of afforestation will continue to occur on marginal agricultural land. If this is the case, then new plantations will not result in the creation of substantial areas of entirely new Hen Harrier habitat, as many of these marginal areas will have been used by Hen Harriers before planting. Therefore, while the area of habitat suitable for Hen Harriers in the IAs will be influenced by forest maturation, and by the felling and replanting of mature forest stands, it is unlikely to be greatly increased by the afforestation of previously open habitats.

The distribution of Hen Harriers within the IAs in relation to percentile classes of suitable habitat indicates that areas with less than 30% cover of bog, rough pasture or young forest are avoided by Hen Harriers. Due to the maturation of the forest estate, this threshold will be exceeded by a far larger proportion of the IAs in 2015 than at present, with the likely consequence that the carrying capacity of these areas for Hen Harriers will decrease. In predicting that this decrease will be in the region of 30% we assume that the populations of Hen Harriers in the IAs are currently at carrying capacity. We also assume that different areas of suitable habitat are comparable in quality (i.e. their ability to support Hen Harriers); especially between habitat types that will contribute different proportions of the total area of suitable habitat in 2015 than they did in 1999 (e.g. young first rotation forest and young second rotation forest). If second rotation habitat is of a lower quality than first rotation, the impact of forest maturation on the Hen Harrier population could be more severe than we have predicted.

If the value to Hen Harriers of new forests planted between 1999 and 2015 greatly exceeds that of the habitats they replace, the carrying capacity of the IAs may, at least during the period under consideration, be less affected by the maturation of the forest estate than we predict. However, such a ‘buffering’ effect of afforestation would be temporary at best, as Hen Harriers can only use a piece of forested land for a third of the time after it has been planted with trees, and, as we have discussed, the value of second rotation forestry in relation to other suitable habitats is unknown. Similarly, if first rotation pre-thicket forests were

of greater value to Hen Harriers than some of the open components of suitable habitat (i.e. bogs, heaths, and wet grassland), then canopy closure of these forests could have a disproportionate impact on Hen Harriers.

Recommendations

- Afforestation and agricultural improvement should be regulated in the IAs, to minimise further decreases in the carrying capacity of these areas for Hen Harriers. Wherever possible, afforestation should target improved agricultural land in the IAs, rather than bog, heath and rough pasture.
- The findings of this study suggest that 3 km^2 may be an appropriate scale at which to evaluate habitat composition within the IAs, as there is a clear association between Hen Harrier occupancy and habitat composition at this scale (i.e. within a 1 km radius). If a proposed change in land use would decrease the proportion of any 3 km^2 area of land in the IAs to below 30% (below which threshold Hen Harrier occupancy is substantially lower than at higher levels of suitable habitat cover), it should be regarded as being potentially damaging to Hen Harriers.
- Where Hen Harriers occupy heavily afforested areas a mosaic of different age classes should be developed, so that forests within any 3 km^2 area are composed of close to one third pre-canopy closure forest at any one time. In areas of continuous forest, blocks of greater than 100 ha that are composed stands within 14 years of each other should be avoided. Such large, contiguous areas of similarly aged forest could reduce the value of the surrounding landscape to Hen Harriers by reducing the overall availability of suitable habitat within 1 km to below 30%. This threshold assumes that Hen Harriers will continue to breed in areas of extensive forest cover if sufficient young second rotation forest is available.
- The development of a custom-designed GIS would allow the effects of a proposed change in land use on the proportion of suitable habitat cover in the surrounding area to be easily evaluated in the context of existing land uses. The GIS could also enable landscape change to be predicted, allowing proposals to be evaluated in the light of future impacts on suitable habitat available to Hen Harriers. In conjunction with data from subsequent Hen Harrier surveys, it could be used to test and refine the predictions of this study.
- More detailed habitat data should be collected from the IAs. In particular, a detailed inventory of all forests (both private and Coillte-owned) in the IAs, to include planting species, planting year and projected felling year, should by compiled and kept up to date. Such habitat data would be essential in implementing the recommendations presented here; and would greatly facilitate further research on the habitat requirements of Hen Harriers. They would also enable validation and/or refinement of the associations between Hen Harriers and land use described here, and possible refinement of the recommendations.

Photo: Jiri Bohdal

- Our understanding of Hen Harrier habitat requirements also needs to be improved, through combined satellite- or radio-tracking study of foraging adults, and monitoring of the fledging success of Hen Harrier nests in different habitat configurations.
- Although preliminary indications are that Hen Harriers will use second rotation forests for both hunting and foraging, we need to acquire a better understanding of the value of young second rotation forest for breeding Hen Harriers before we can be certain that forest habitats will continue to provide suitable habitat for Hen Harriers in the long term.
- Until we improve our understanding of Hen Harrier habitat requirements, a combined limit of *at least* 70% should therefore apply to improved agricultural land and plantation forestry, when considering proposals to convert an area of bog or rough pasture to either of these land cover types in Hen Harrier IAs.

Photo: Brian McGeough

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