2015

Hen Harrier Conservation and the Forestry Sector in Ireland

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Preface

Directive 2009/147/EC or the Birds Directive provides a comprehensive scheme of protection for all wild birds naturally occurring in the European Union. The Directive instructs Member States to maintain the populations of wild bird species at a level which corresponds in particular to ecological, scientific and cultural requirements, while taking account of economic and recreational requirements. In light of this requirement Ireland, along with other Member States, shall take the requisite measures to preserve, maintain or re-establish a sufficient diversity and area of habitats for its wild bird species.

The Directive also requires the classification of suitable areas as Special Protection Areas (SPAs) for the protection of certain bird species, including the Hen Harrier. Under Article 6 of the Habitats Directive, which applies to SPAs, Ireland is obliged to prevent the deterioration of these SPAs (as suitable areas for the species) and only to consent to projects where there is clear scientific evidence that such projects will not lead to an adverse impact on the integrity of the SPA or qualifying features. The Court of Justice of the European Union, in a number of its findings regarding the interpretation of these Directives, has emphasised the importance of scientific understanding of the impact of proposed interventions, and where there is scientific doubt as to the potential impacts on the species, the precautionary principle must apply.

This report specifically examines the interactions between the forestry sector and Hen Harrier conservation in Ireland. The purpose of this report is to inform the Hen Harrier Threat Response Plan (HHTRP) with a view to integrate the forestry related findings with those from other relevant sectoral pressures, e.g. agriculture and wind farm development, in order to prescribe a collaborative way forward for the conservation of this species.

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CHAPTER 1: INTRODUCTION

Background

The National Parks and Wildlife Service (NPWS) at the Department of Arts, Heritage and the Gaeltacht are responsible for co-ordinating the conservation of natural habitats and species and the protection of biological diversity in Ireland.

Under regulation 39 of the European Communities (Birds and Natural Habitats) Regulations 2011 provision is made to develop and implement appropriate threat response plans. The purpose of such a plan would be to cease, avoid, reduce or prevent threats, pressures or hazards that may be having an adverse effect on the conservation status of a species of bird referred to in Article 1 of the Birds Directive and/or causing the deterioration of the habitats of species for which a European Site has been classified pursuant to the Birds Directive.

The Hen Harrier *Circus cyaneus* is listed on Annex 1 of the Birds Directive (Directive 2009/147/EC) and is Amber listed on the Birds of Conservation Concern in Ireland (Colhoun & Cummins, 2013). In 2007, six European Sites (Special Protection Areas) were designated for the conservation of this breeding species. Hen Harriers are also listed at a further two SPAs that support important roost sites outside the breeding season (see Appendix 1). A survey of breeding Hen Harrier in 2010 recorded 128 to 172 breeding pairs (Ruddock et al., 2012) which was broadly similar to the totals recorded in the previous survey in 2005 (Barton et al., 2006). However notable declines were recorded in some of the stronghold sites that were designated as SPAs for this species (Ruddock et al., 2012).

Recent research raised the possibility that this species may be subject to an ecological trap due to its habitat preferences in Ireland. This coupled with concerns that the extent and rate of change to the Hen Harrier's habitat including continued afforestation and an increase in the rate of wind farm development and agricultural intensification among others were linked to the recently recorded declines led to the decision to develop a Hen Harrier Threat Response Plan (HHTRP). This document forms part of the overall HHTRP process and focuses on reviewing the interactions of the forestry sector and the conservation of the Hen Harrier population in Ireland.

The Hen Harrier in Ireland

The Hen Harrier is a widespread but patchily distributed breeding bird across much of northern and central Europe. This European breeding range equates to less than one quarter of this Harrier species global range (Cramp & Simmons, 1980; Simmons, 2000). The European breeding population is considered to be relatively small (estimated at 32,000 – 59,000 breeding pairs (Birdlife International, 2004)). As the Hen Harrier underwent a large decline during the period 1970 – 1990 its European conservation status is regarded as 'unfavourable' (BirdLife International, 2004). This species is migratory in the northern parts of its range in

north and northeast Europe, Asia and North America; and partially migratory and dispersive in the rest of its breeding range (del Hoyo et al., 1992).

O'Donoghue (2004) described the modern landscape of the Irish breeding Hen Harrier as: upland, typically above 100m above sea level (asl) and dominated by pastoral based livestock farming with holdings often covered in rushes and bordered by hedgerows; active and degraded peatland; scrub; and commercial plantations of different ages. Breeding Hen Harriers in Ireland typically avoid agriculturally improved land for nesting (Wilson et al., 2009), although the species will forage along hedgerows and linear features (Madders, 2000; 2003a). Hen Harrier populations in Ireland are now breeding predominantly in forested landscapes (Barton et al., 2006; O'Donoghue, 2010; Ruddock et al., 2012) which have replaced open heath-dominated upland habitats (O'Flynn, 1983). Conversely in the UK the Hen Harrier is recorded more frequently nesting in moorland (Redpath et al., 1998; Sim et al., 2007; Hayhow et al., 2013).

The foraging habitat preferences of Hen Harriers in Ireland are generally biased towards moorland, grassland mosaics and prethicket forest habitats (see O'Donoghue, 2004; 2010; Barton et al., 2006; Irwin et al., 2012) which support larger numbers of Hen Harrier preferred prey species, such as Meadow Pipit (*Anthus pratensis*) and Skylark (*Alauda arvensis*). Hen Harriers breeding numbers are typically correlated with the abundance of small mammals in the UK (Redpath et al., 2002a; 2002b; Thirgood et al., 2003), however this relationship does not appear to exist in Ireland perhaps due to the absence of short-tailed vole (*Microtus agrestis*) (see O'Donoghue, 2010). Preferred prey species in Ireland are Meadow Pipit, Wood Mouse (*Apodemus sylvaticus*) and other small passerines during the breeding season whilst Meadow Pipit, Brown Rat (*Rattus norvegicus*) and wintering thrushes predominate in winter (O'Donoghue, 2010).

A history of the Irish Hen Harrier population (1800s – 1980s)

From the earliest documented records in the 1850s, Hen Harriers were generally distributed throughout Ireland with breeding strongholds in Kerry, Wicklow and the Tipperary/Waterford border in the south, and Derry and Antrim in the north (Thompson, 1849). The Hen Harrier was also found breeding in Connemara (Shawe-Taylor in Watson, 1977). By 1900, the Hen Harrier was recorded in counties Kerry, Cork, Limerick, Tipperary, Waterford, Wicklow, Dublin, Offaly, Laois, Galway, Mayo, Fermanagh, Donegal, Derry, Antrim and Down, however it was noted that the population was in decline and no longer present in some historical breeding areas (Ussher & Warren, 1900). At this time Hen Harriers were considered to have been widely persecuted in Ireland (primarily through the destruction of young and eggs) throughout the latter half of the 19th century (Usher & Warren, 1900; O'Flynn, 1983). Indeed this species was considered by some to have become extinct as a breeding species in Ireland altogether by the early 1950s (Kennedy et al., 1954; Bannerman & Lodge, 1956). However small numbers continued to breed in a few areas such as the Slieve Bloom Mountains in Laois, the Tipperary/Waterford border and the Cork/Kerry border (Watson, 1977). There is no accurate historical estimate of Ireland's total breeding population

during the early 1950s. However it is considered that the Irish population was at historically low levels with regard to numbers and breeding distribution.

It is considered that a recovery in the population started in the 1950s (Andrews, 1964). In 1956 breeding pairs were found in Waterford, south Kilkenny and Cork (O'Flynn, 1983), re-colonising Wicklow soon after, with seven breeding pairs recorded in the county in 1961 (Scott, 1995). By 1964 at least 35 pairs were known to be breeding in six southern counties (O'Flynn 1983). In the Atlas of Breeding Birds in Britain and Ireland (Sharrock, 1976) an all-Ireland breeding population estimate of 200 – 300 pairs is given with confirmed or probable breeding records from 17 counties. The distribution was based on fieldwork which was undertaken during the period 1968 – 72. A slightly increased estimate of 250 – 300 pairs is reported for the period 1973-75 (Watson, 1977).

O'Flynn (1983) considered that the recovery of the Hen Harrier breeding population from the 1950s onwards appeared to have been due to an increased availability of secure nest sites and passerine prey species. O'Flynn (1983) cites the government's adoption of a long-term afforestation plan in 1947 of circa 400,000ha to be planted over 40 years as the likely driver of this change with Hen Harriers using the recently afforested (i.e. pre-thicket) areas to both nest in and forage over.

In the latter half of the 1970s O'Flynn (1983) suspected that the population was no longer increasing. After further investigation he concluded that the population had declined significantly in some areas (e.g. Wicklow from over 20 pairs in 1965 to two or three pairs in 1982) with apparent local extinctions occurring in other areas (e.g. Slieve Aughty Mountains, the Ballyhoura Mountains, hills of north Tipperary, hills of south Kilkenny and the Comeragh Mountains in Waterford). O'Flynn (1983) noted that by the mid-1970s the earlier planted conifer forests had grown to maturity resulting in a direct negative impact on the availability of suitable prey. Coincident changes to open, non-forested habitats in Hen Harrier breeding areas were also occurring at this time and partly attributed to Ireland's entry into the European Economic Community (EEC) in 1973 and the subsequent changes in land use initiated by significant investment through the Common Agricultural Policy. O'Flynn (1983) considered that tracts of scrub and gorse covered marginal land which had provided a productive hunting habitat for the Hen Harrier were cleared and transformed into improved grassland. The combination of the maturation of forest estate and the clearance of marginal land was considered by O'Flynn (1983) to be the main reason for the Hen Harrier breeding population decline of the late 1970s.

Recent population trends

A second breeding bird atlas was undertaken during the period 1988-91 and an all-Ireland population of 180 breeding pairs was estimated based on an extrapolation of density estimates across the areas of confirmed or probable breeding (Gibbons et al., 1993). The first national Hen Harrier survey in the Republic of Ireland was conducted during the breeding seasons of 1998 - 2000 and estimated a breeding population of 102 - 129 pairs (Norriss et al.,

2002). A second national survey was undertaken in 2005 and established a national population estimate of 132 – 153 territorial pairs. This represented an increase of over 18% from the first national survey; an increase partially explained by increased survey coverage in 2005 (Barton et al., 2006). Combining the results with comparable surveys undertaken in Northern Ireland (Sim et al., 2001; Sim et al., 2007), Barton et al. (2006) established all-Ireland estimates of 130-167 and 190–221 territorial pairs in 1998–2000 and 2005 respectively, equivalent to an increase of over 24% in that period.

The third national survey, undertaken in 2010, estimated a breeding population of between 128 to 172 territorial pairs occurring in sixty nine 10km grid squares (Figure 1). A separate survey in Northern Ireland estimated 59 proven and probable territorial pairs (Hayhow et al., 2013), providing an all-Ireland estimate of 158 to 205 pairs (Ruddock et al., 2012). These survey results indicated that the Hen Harrier population appeared to be stable however the accuracy of comparing the 2005 and 2010 national estimates was complicated due to more than double the surveyor effort in the 2010 survey (Ruddock et al., 2012). The coverage of the 2010 national survey included the 10km squares surveyed in 2005 and therefore a more accurate estimate was derived by Ruddock et al. (2012) by comparing the number of breeding pairs in this subset. Analysis of one hundred and thirteen 10km grid squares surveyed in both years calculated a population decrease of 6.4% over that period.

A similar sub-sample approach for 84 10km squares surveyed during respective surveys undertaken in 1998-2000 and 2010 showed a short term national population decline of 11 – 14% and 6% reduction in breeding range over this period (see NPWS 2013a). The 2007 – 2011 Bird Atlas (see Balmer et al., 2013) presents the breeding distribution of Hen Harrier within 99 10 km squares in Ireland but differences in survey methodology and survey effort complicate the interpretation. A large proportion of the records submitted to this bird atlas were derived from the 2010 national survey

Particular concerns are raised on the basis of the observed declines in the abundance of breeding birds in the Hen Harrier strongholds several of which are designated as SPAs. Six sites have been designated as SPAs for breeding Hen Harriers in Ireland (Figure 2). The combined breeding Hen Harrier populations within these SPAs during the 2010 national survey (Ruddock et al., 2012) recorded between 55 and 77 territorial pairs, a decline of 18.1% compared to the results of the 2005 survey. These six areas comprise a combined area of 167,297 hectares (ha) and consist mainly of non-native coniferous plantation forests, open upland peatland habitats, and a spectrum of improved and unmanaged agricultural grasslands (NPWS, 2007). It is estimated that approximately 52% of the total land area in the SPA network designated for breeding Hen Harrier is forestry.

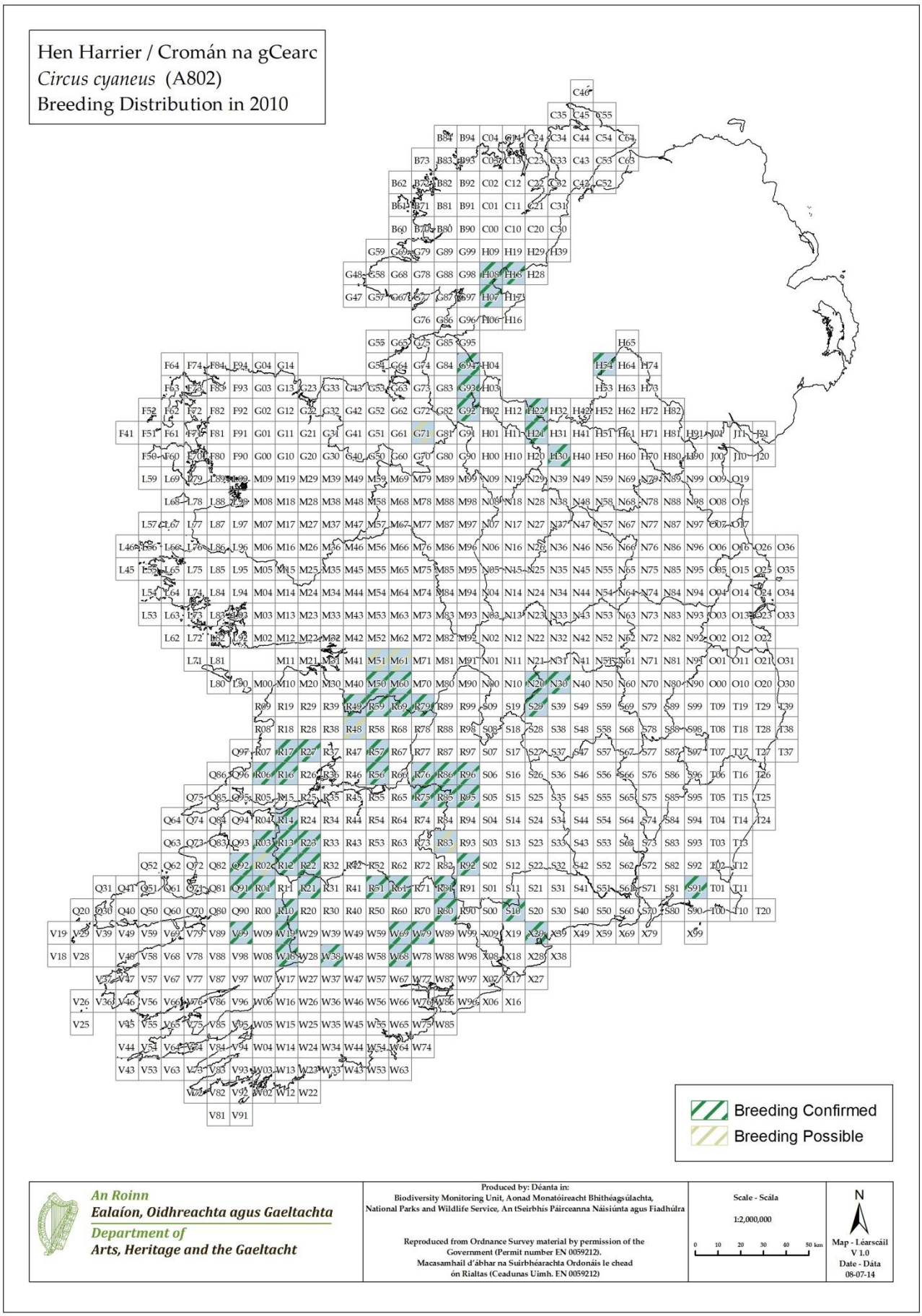

Figure 1 Distribution of Breeding Hen Harrier in 2010

Outside the Breeding Season

The winter distribution of Hen Harriers in Ireland significantly differs from that during the breeding season (Figure 3). During the non-breeding season, which can be broadly defined as mid-August to mid-March, Hen Harriers may disperse from the breeding sites with the majority of marked young birds born in Ireland re-sighted within 150km of their natal site (O'Donoghue, 2010). O'Donoghue's (2010) work indicated that Irish Hen Harriers were largely resident as it showed that a minority of the re-sighting data of Irish bred birds came from Britain. There are evident links between Ireland and Britain with records of Scottish bred birds re-sighted in Ireland but the level of cross-over of birds during the breeding and non-breeding periods has yet to be established with certainty (Etheridge & Summers, 2006; O'Donoghue, 2010).

Hen Harrier wintering grounds are typically lowland sites below 100m (Clarke & Watson, 1990; 1997; O'Donoghue, 2010). During winter, Hen Harriers gather at communal roost sites at night (Watson & Dickson, 1972). Roost sites can be communal (frequently used by several birds and other raptors) or solitary (used by individual birds regularly or infrequently) (see Clarke & Watson, 1990). Hen Harriers select sites with suitable cover, low ambient levels of disturbance and presumably close to suitable foraging areas to roost (O'Donoghue, 2010). In Ireland the majority of roosts are located in reedbeds, heather/bog and rank/rough grassland but also fen, bracken gorse and saltmarsh (Watson, 1977; O'Donoghue, 2010). Approximately 20% of known roost sites in Ireland occur within close proximity to core nesting areas. Only a small number of known roosts are found in forested habitats (O'Donoghue, 2010). The numbers of individual birds occupying each roost site at any one time outside of the breeding period are highly variable and patterns of roost site use are poorly understood. In 2014, approximately 96 confirmed winter solitary and communal roosts are known in Ireland, estimated to support between 219 – 313 individuals (B. O'Donoghue, pers comm).

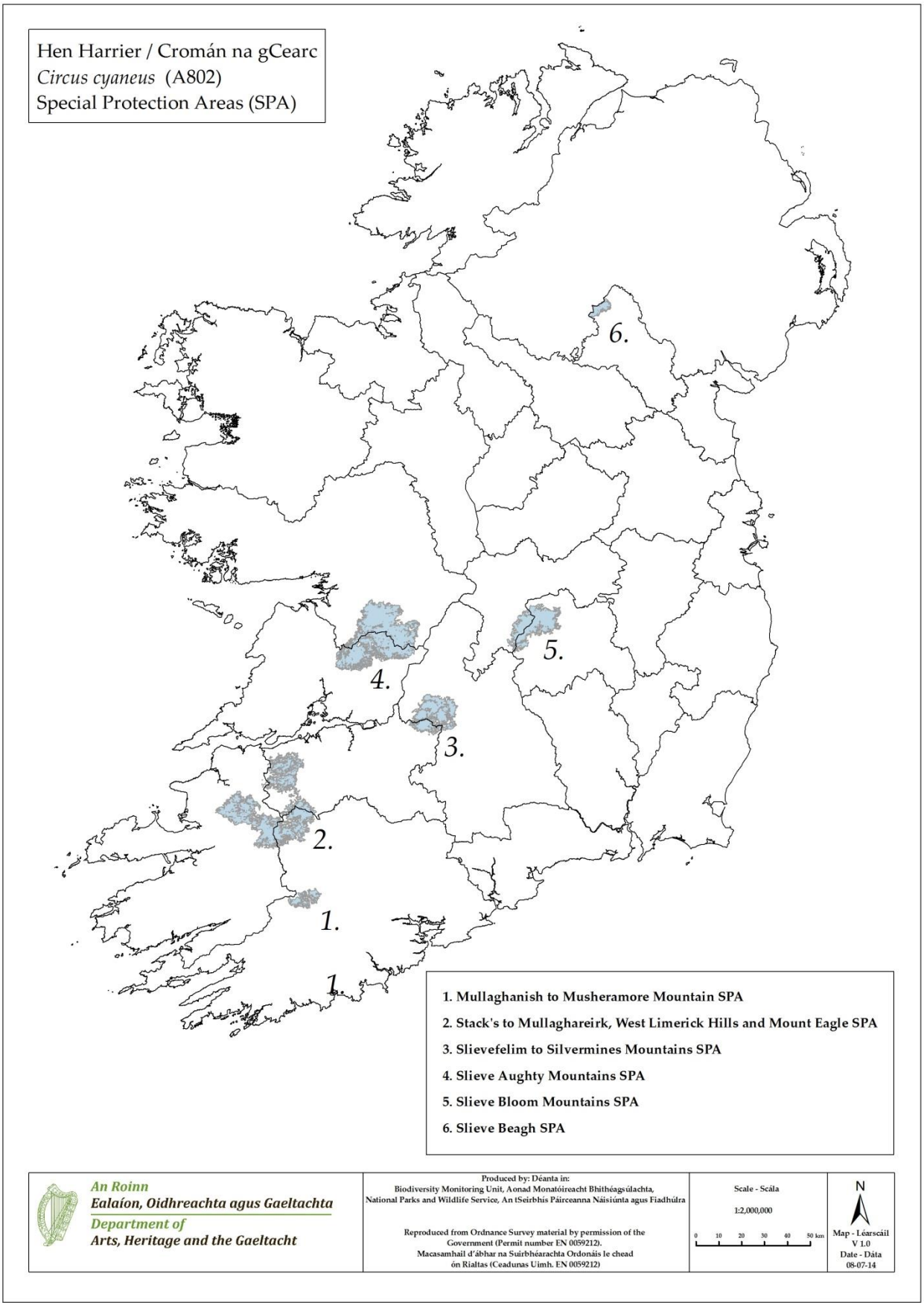

Figure 2 The SPA Network for breeding Hen Harrier

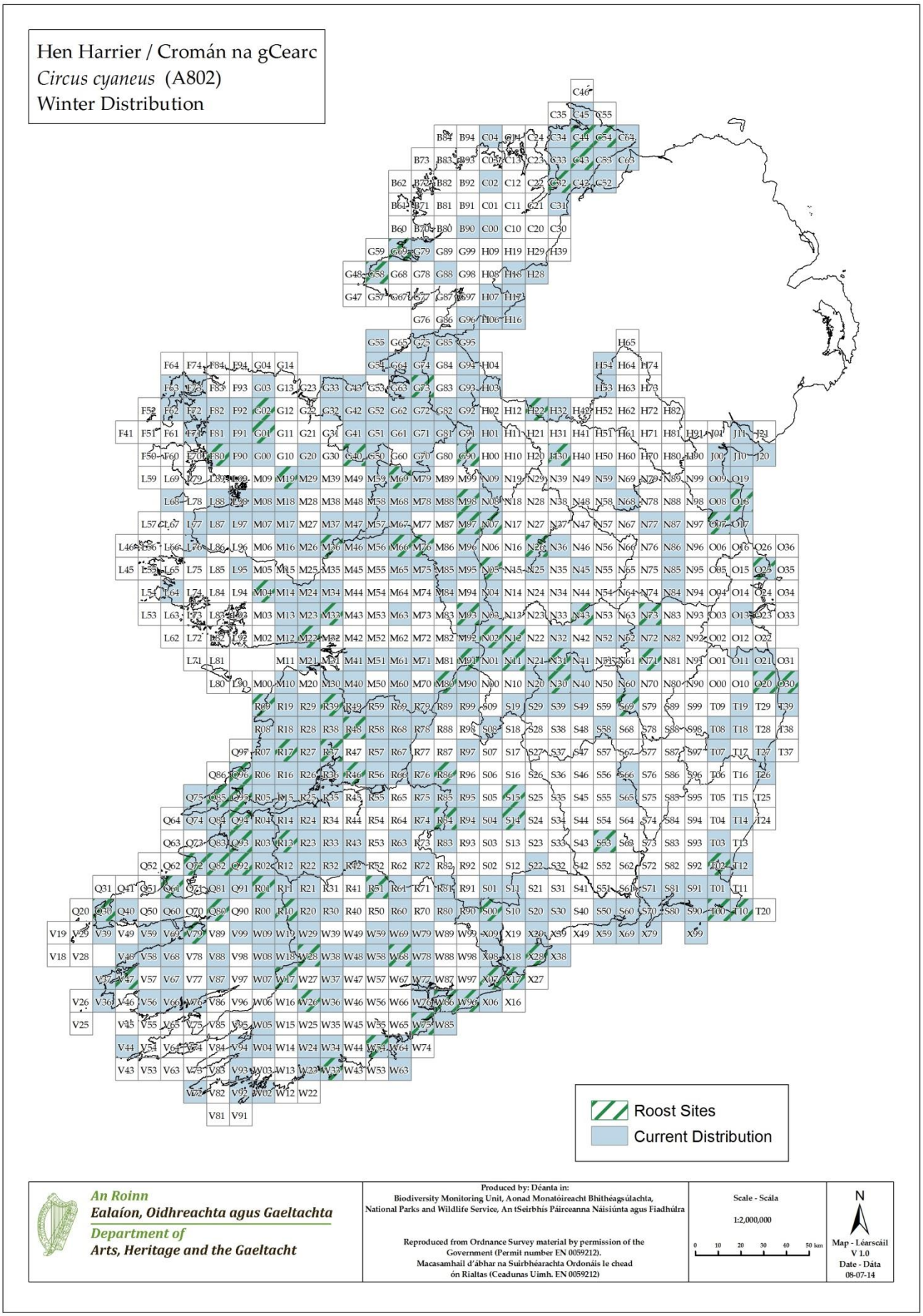

Figure 3 The Distribution of wintering Hen Harrier (Distribution data from the 2007-11 Bird Atlas; Roost site locations from unpublished Irish Winter Hen Harrier Survey data)

The Forestry Sector in Ireland

After the last Ice Age, Ireland was dominated by tundra-like vegetation. A change in climate led to an expansion of woodland over the millennia. From the Neolithic period onwards humans began to clear the forests for agriculture and by Medieval times very little native woodland remained (Cross, 2012).

The development of forest in modern Ireland:

By 1900, less than 1% of Ireland's land area comprised of woodland. State forestry initiatives during the second half of the twentieth century increased forest cover to almost 10%, largely through the planting of non-native tree species (see Figure 4). Food Harvest 2020 recommends that the forestry sector (both Department of Agriculture Food and the Marine (DAFM) and industry) should further explore measures to bring about a significant increase in the annual rates of afforestation (DAFF, 2012). DAFM's 2014 policy report "Forests, products and people" sets out that the afforestation target will be 10,000ha per annum up to 2015 and that this target will increase to 15,000ha per annum for the period 2016 to 2046. This rate of afforestation along with reforestation of clearfell areas is to provide a forest cover of 18%. Within the context of this policy and Food Harvest 2020 DAFM is to develop an integrated approach to the achievement of these target across land uses and schemes (DAFM 2014).

In the past peatland habitats have been the main afforested soil type in Ireland, both overall (accounting for 52% of all afforestation) and in every ten-year period after 1956 (Wilson et al., 2012b). The peatlands that are most frequently afforested in Ireland are blanket bogs and wet heaths (Smith et al., 2006). Until 1955, the majority of afforestation occurred on well-drained soils. The proportion of planting on peat increased between 1956 (12%) and 1985 (71%), and subsequently declined to 43% between 1996 and 2005. Between 1956 and 1985, the proportions of planting on gley, podzol and well-drained soils all decreased (25 to 9%, 16 to 6% and 15 to 4% respectively). After 1986, the proportion of afforestation on gley increased substantially, reaching a maximum of 40% between 1996 and 2005. There has been a general downward trend of peatland planting since 1990 (Black et al., 2008).

The principal approach to management within commercial conifer forests in Ireland revolves around a 40-60 year rotation comprising afforestation, thinning, clearfelling and replanting. Thinning is undertaken to primarily enhance the quality of the final crop, and also to provide intermediate yields of timber. Clearfelling involves the harvesting of all trees in a stand at the end of the rotation, with restocking subsequently undertaken to replace the harvested trees (Forest Service, 2000).

An estimated 75% of the national forest estate is predominantly conifer (Forest Service, National Forest Inventory dataset 2012). Approximately 57% is Sitka spruce *Sitea pitchensis* of which the investment cycle, dependant on yield class (i.e. productivity) can range from 32 to 52 years (Lekwadi et al., 2012). In general terms, thinning of Sitka spruce commences anytime between the ages of 15 and 22 years growth and every four or five years from then

on until final felling (Forest Service, 2014). For pine species this investment cycle is longer ranging from 50 to 70 years (Horgan et al., 2003).

Other silvicultural methods are available, including Continuous Cover Forest systems (see Ní Dhubháin, Á. 2010) but these systems may not be appropriate under certain circumstances. These are not widely practiced in Ireland but are growing in relevance, due in part to their suitability within particular environmentally sensitive areas.

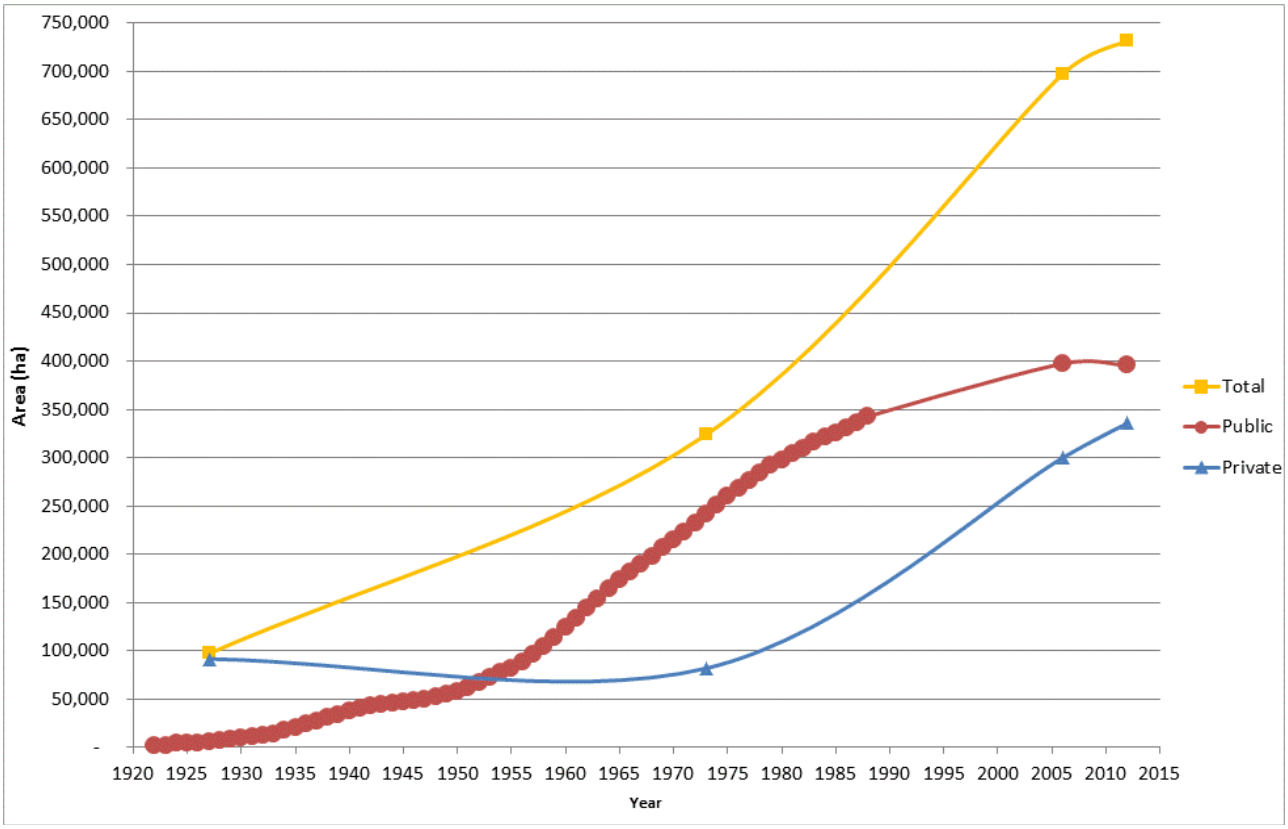

Figure 4 Forest area change since the foundation of the State, 1922-2014 (as per DAFM Annual Statistics 2014)

The Forest Service

The Forest Service of the DAFM is the body responsible for regulating key forestry activities, including afforestation and forest road constriction (under S.I.558 / 2010), thinning and felling/replanting (under the 1946 Forestry Act, to be replaced with the 2014 Forestry Act (to be commenced) and aerial fertilisation of forests (under S.I. 125/2012). The Forest Service also has key responsibilities under other environmental legislation, including European Communities (Birds and Natural Habitats) Regulations 2011 (S.I.477 / 2011), which imposes an obligation on the Forest Service to be responsible for relevant aspects of the Birds and Habitats Directives. When assessing applications for approvals / licences, the Forest Service must ensure consistency with Article 6 of the Habitats Directive as well inter alia Articles 2, 3, 4 of the Birds Directive. This process is captured in the Forest Service Appropriate Assessment Procedure (AAP) and associated mechanisms regarding particular species, including Hen Harrier. The Forest Service AAP Manual (consolidated version, March 2013) and associated appendices provide great detail on this subject.

The Forest Service provides grant schemes and other supports to promote various components of the forest sector, principally afforestation and forest road construction. As part of the SEA and AA process, the new Forestry Programme for the period 2014 to 2020 is currently undergoing public consultation. The current draft include targets for afforestation set at 46,000 ha over the 6-year programme under various planting schemes including the Afforestation Scheme but also the Native Woodland Establishment Scheme, Agro-Forestry Scheme, and Forestry for Fibre Scheme (for further information on the consultation see (see http://www.agriculture.gov.ie/forestservice/publicconsultation/newforestryprogramme2014-2020/).

Hen Harrier Protocol

In 2007 and coincident with the designation of the six breeding Hen Harrier SPAs an agreement between the Forest Service and NPWS was reached setting out various conditions, including limits for afforestation rates at each of the SPAs. Thresholds for annual afforestation were agreed in principle for a 15 year period. Based on scientific data available to them at the time and using expert judgement the thresholds were defined in order that each SPA contained at least 55% suitable habitat. To calculate this value the then estimated extent of the heath/bog and the rough grassland in each SPA was combined with an area of forest that was considered to be suitable (i.e. first rotation up to 12 years old and second rotation plantations aged between 3 – 8 years inclusive). This area of suitable forest was reckoned at the time to be 1/6th of the total extant forest estate within the SPAs for the 15 year period.

The protocol also acknowledged the onus of protecting the bird and its habitats outside of the SPA network and made particular reference to three areas (Ballyhoura Mountains, Nagle Mountains and Kilworth). Provision was also made for increased protection at other sites based on future surveys and research. The protocol was to be reviewed within five years and would be informed by on-going research. In particular aspects of research focussing on how forestry interacted with the breeding success of the Hen Harriers was to be reviewed.

Site specific thresholds for afforestation were based on assumptions that the ratio of rough grassland to improved grassland would largely remain stable over the 15 year period and that forest maturation was the main driver that could lead to a reduction in the extent of the suitable habitat within the SPA network (NPWS, 2007). The Hen Harrier conservation landscape changed significantly after the protocol was reached, notably:

- the EU Commission considered that the Protocol was subject to the provisions of the SEA directive;
- the rate of wind farm development in upland areas increased and along with this came further information estimating the negative impact of such developments on foraging Hen Harrier and its prey species (Pearce-Higgins et al., 2009b; 2012; O'Donoghue, 2011);
- the 2010 Hen Harrier Survey recorded acute declines in several of the Hen Harrier SPAs with an overall decline of over 18% across the network (Ruddock et al., 2012);

- concerns of further habitat loss based on anecdotal observations of widespread removal of scrub and the damage of heath in Hen Harrier SPAs in order for landowners to qualify for single farm payments arose;
- in 2012 the PLANFORBIO report to DAFM noted that an analyses of data suggests that in some parts of their range Hen Harrier are decreasing and that low levels of breeding success may be a contributing factor to the decline; at one of their study areas a negative association between second rotation pre-thicket forest and breeding success was identified (Irwin et al. 2012).

On account of these issues the Hen Harrier protocol was modified and eventually suspended and the HHTRP was progressed. Table 1 sets out details on the relevant procedures that were active over this period.

Table 1 List of events supplied by Forest Service

Period procedure in place	***Outline of procedure implemented by the Forest Service***
Prior to 2 August 2011	Subject to *de facto* screening involving a case-by-case examination, by taking account of the qualifying interests and conservation objectives of the relevant Natura site(s) and feedback from consultation.
2 August 2011 onwards	Circular 13/2011: Draft Appropriate Assessment Procedure (AAP) Information Note released as a working document, 18 July 2011. Use of associated AA Screening Forms by Inspectors for afforestation files commenced, 02 August 2011. Revised AAP Information Note (Circular 02/2012) released, 13 March 2012, updating Forest Service AAP to incorporate feedback from consultation and Birds & Habitats Regulations 2011.
13 March 2007 → 30 June 2011	Management Protocol for Afforestation in Hen Harrier SPAs in place, which provided the basis for appropriate assessment screening. Possibility of significant effect on Hen Harrier SPA deemed unlikely where criteria of the protocol were met, thereby negating the need for an actual appropriate assessment. The Hen Harrier protocol with a 15 year quota was suspended in February 2010. However, the basis of the protocol continued to be applied on a case-by-case basis, providing the basis for AA screening during this period. Forest Service monitored cumulative afforestation within each SPA.
1 July 2011 → 12 March 2012	Circular 10/2011: Procedures for Assessing Afforestation Applications in Hen Harrier Areas for 2011 released, setting out maximum levels for afforestation in each Hen Harrier SPA for 2011 / 2012 planting season, based on assessment of habitat, existing forest (including recent afforestation and applications approved and not yet planted) and windfarms. The procedure provided the basis for AA screening. Forest Service continues to monitor cumulative afforestation within each SPA. Circular 13/2011: Draft Appropriate Assessment Procedure (AAP) Information Note released as a working document, 18 July 2011. Use of associated AA Screening Forms by Inspectors for afforestation files commenced, 02 August 2011.
13 March 2012 onwards	Revised AAP Information Note (Circular 02/2012) released. Main changes to 18 July 2011 version include: • refinement of Hen Harrier disturbance operations procedures, in consultation with NPWS; • incorporation of Birds & Habitats Regulations 2011, in consultation with NPWS; and • integration of two Hen Harrier procedures (afforestation and disturbance operations) into AAP.

Current forestry context

As of January 2015 the Forest Service is not issuing any further afforestation licences within the six breeding Hen Harrier SPAs. A total of 269 applications to plant within or adjacent to Hen Harriers SPAs are currently with the Forest Service representing a combined area of 1,011ha (IFORIS, 2014 unpublished data). The Forest Service is issuing approvals for forest road construction and felling licences for thinning and clear felling (and associated replanting) subject to various environmental conditions including the requirement to minimise the impact of direct disturbance effects on breeding Hen Harriers in these areas. This is achieved by identifying current areas of high sensitivity within the SPAs that contain or are likely to contain active nesting pairs. The identification of these 'Red Areas' was informed by the National Hen Harrier Surveys of 2005 and 2010. The Forest Service is made aware of any new breeding areas known to NPWS which results in an updating of the relevant red area maps. Within these areas specific procedures apply in relation to applications for consent / grant approval / licences involving certain forestry operations which have the potential to disturb Hen Harrier breeding activity within and surrounding SPAs designated for the species. For more information on this see http://www.agriculture.gov.ie/media/migration/forestry/grantandpremiumschemes/schemecirculars/AppendixCAAPRequirementsHenHarrierSPAsFelling140312.pdf.

Due to the pattern of past planting, future timber supply is estimated to peak around 2035 (Phillips, 2011). The projections show that in the absence of any future afforestation, there would be a dramatic decline in future supplies from 2035 onwards which would have serious consequences for the forestry sector. A continuation of afforestation, to target levels set by the government (currently at 10,000ha per annum but rising to 15,000ha per annum) is required to achieve a national forest cover of 18% and to maintain a sustainable level of supply of timber beyond 2020 (DAFM, 2014)

An Indicative Forest Statement Category Map of Ireland (Figure 5) contained in a report produced by the Forest Service (2008) entitled "*Indicative Forestry Statement – the right trees in the right place*" shows the country broken down in four broad categories to identify opportunity and constraint areas for afforestation:

1. Suitable for a range of forest types;
2. Suitable for certain types of forest development;
3. Suitable, where appropriate, for nature conservation and/or amenity forests; and
4. Unsuitable, unproductive or unplantable areas.

Afforestation is to take place largely in categories 1 and 2. Teagasc is undertaking further research looking at the combined effect of environmental factors on forest production in order to identify factors that will result in increased forest productivity (Forest Service, 2008). It should be noted that these categories are indicative and that every site is assessed on its merit regardless of what category applies.

Such areas include primarily 'improved land' but the grant scheme allows a proportion of the total area eligible to be unenclosed. Forest Service's Circular 18/2011 ('Land Types') describes unenclosed land as land which is normally associated with peat soils or other poor soils and includes areas that have not been cultivated or brought under intensive commercial agricultural use successfully over a sustained period. These lands are generally used for extensive grazing and have low levels of existing agricultural productivity. Forest Service's Circular 10/2010 sets out a number of changes to the Afforestation Grant and Premium Schemes including that the amount of unenclosed land in any application for financial approval cannot exceed 20% of the total area.

The 20% threshold for unenclosed land, as per Forest Service Circular 10/2010, remains in place under the new Forestry Programme. Discussions are currently ongoing within the COFORD Council Land Availability Working Group (CCLAWG) on possible changes to this. Any change agreed within the CCLAWG will subsequently need to undergo wider consultation, before any change in policy can be considered. (Kevin Collins *pers. com.*).

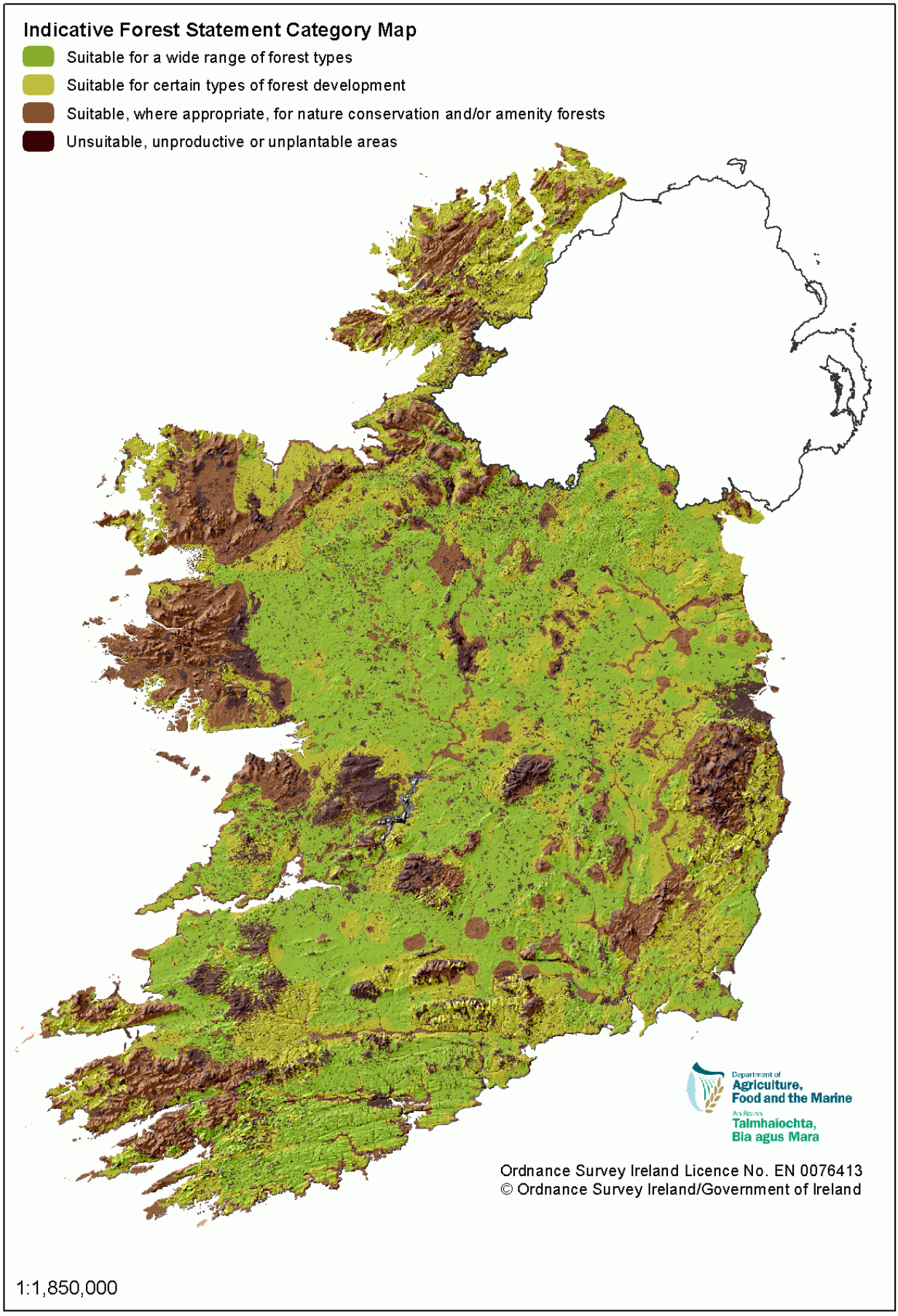

Figure 5 Indicative Forest Statement Category Map of Ireland

Forest Biodiversity Guidelines

The Forest Service sets out the Irish National Forest Standard (2000) and Code of Best Forest Practice (2000), which provide direction for sustainable forest management and a suite of mandatory environmental guidelines for forestry operations covering inter alia water quality, archaeology, the landscape, harvesting, and biodiversity. Additional mandatory guidelines and requirements address Forest Protection and the protection of Otter, Kerry Slug, and Freshwater Pearl Mussel.

The Forest Biodiversity Guidelines require that in sites greater than 10ha to be afforested, Areas of Biodiversity Enhancement (ABEs) should comprise 15% of the area. In Hen Harrier SPAs these ABEs equate to 20% of the overall footprint and are described as follows:

- ABEs are areas suitable for planting where the potential for a commercial forest crop is foregone for the purpose of retaining open spaces and habitats for biodiversity.
- The area occupied by linear features (e.g. hedgerows, public road setbacks etc.) or point features (e.g. archaeological sites) must be accurately assessed and noted on the biodiversity map. This area constitutes a part of the overall ABE area.
- ABEs must be an integral part of the proposed forest area.
- ABEs must be situated where they provide the best opportunity for enhancing the biodiversity within the forest area while also protecting watercourses and archaeological sites through the use of buffer and exclusion zones.
- Existing forests (conifer and broadleaf), or parts of existing forests, may not be used as ABEs. To be deemed a forest it must have a minimum area of 0.1ha and a minimum width of 20m. Other tree covered areas with smaller dimensions to a forest may be included as ABE.
- Afforestation sites can include ABEs greater than the prescribed percentage. However the payable area (for grants and premiums) is adjusted accordingly.

Forest management

After afforestation the consequent broad actions that may apply are: thinning; forest road construction; clear felling and restocking; and, to a lesser degree, aerial fertilisation. Each of these activities within and surrounding SPAs are subject to screening pursuant to the Appropriate Assessment Procedure (AAP) including the associated Red Areas approach (see https://www.agriculture.gov.ie/media/migration/forestry/grantandpremiumschemes/schemecirculars/AppendixCAAPRequirementsHenHarrierSPAsFelling140312.pdf) and subsequently approved or licenced when no possibility of effects, or specific conditions are met to minimise direct disturbance events to the breeding Hen Harriers. This 'Red Area' approach is currently confined to the six SPAs and therefore reducing the risks of forestry related disturbance to harriers breeding in non-designated areas is currently dependent upon a less robust and *ad hoc* approach.

Thinning: Thinning increases the total volume yield of usable timber over the lifetime of the crop and provides an intermediate source of timber and revenue before clear felling. The thinning cycle for fastest growing conifers on a short rotation, varies from four to six years, however it can be up to 10 years for slow growing species. Factors such as

market demand, species, yield class, rotation length and susceptibility to wind throw determine the frequency and number of thinnings, if any, to be carried out (Forest Service, 2014).

Forest Road Construction: Harvest roads are generally constructed in advance of first thinning operations to allow the road to dry and cope better with harvesting and timber haulage. The Forest Service provides grant aid up to 80% of the cost towards the construction of harvest roads. Road construction activities require approval from Forest Service under S.I. 558/2010 and must adhere to the Forest Road Manual (Ryan et al., 2004) and other guidelines (including *Forest Harvesting and the Environment Guidelines*) to minimise the impacts on the local environment. An Environmental Impact Statement (EIS) is required for forest road construction projects which exceed 2km. Sub-threshold EIA screening is also in place for this activity.

Clear felling: this normally takes place around the age that maximises financial yield, although other factors may prompt felling before or after this point. Timing of clear felling, like thinning, depends largely on the species and the yield class, but is also determined by stocking rates, thinning history, previous management, plantation size, threat of windthrow, market price and distance from markets, and also economies of scale regarding adjoining areas for felling.

Restocking: Restocking is the replanting of existing areas of forestry that have been harvested. Restocking is currently compulsory under the Forestry Act of 1946 in the case of all general felling licences. However this obligation may be waivered at the discretion of the Minister under a Limited Felling Licence. The restocking phase can be used to redesign a forest to enhance species diversification and this allows for targeted deforestation by introducing unplanted setbacks and ridelines among others.

Aerial Fertilisation: This activity is controlled under S.I. 125 of 2012. Aerial fertilising is carried out mainly on peat soils and peaty podzols where phosphorus and/or nitrogen limit the growth of established forest plantations.

CHAPTER 2: INTERACTIONS OF FORESTRY RELATED ACTIVITIES & THE HEN HARRIER IN IRELAND

Introduction

This chapter outlines the potential overlaps and interactions between forestry related activities and the Hen Harrier in Ireland. It aims to provide an overview of such interactions on both the breeding and non-breeding aspects of the Irish Hen Harrier population and for areas within and outside of the SPA Network. This review is largely based on scientific publications and reports, the majority of which are from peer reviewed sources. Greater detail and ancillary information on the interactions between the forestry and Hen Harrier conservation can be found in Appendix 2.

Nesting Habitat

Based on the first two national Hen Harrier surveys (see Norriss et al., 2002 and Barton et al., 2006), Wilson et al. (2009) examined the locations of 148 Hen Harrier nests in order to assess nest-site selection. The main nesting habitats selected were pre-thicket stage of first and, particularly, second rotation plantations. For this analyses pre—thicket first rotation was considered to be all first rotation forests between 1 – 12 years of age. All forested land recorded as having been clear-felled 3 – 9 years previously, or originally planted 45 years previously, were assigned the second rotation pre-thicket category.

Hen Harriers have been recorded nesting in mature trees in Northern Ireland (Scott et al., 1991; Ruddock et al., 2008) but incidences of tree nesting Hen Harriers have not been documented in the Republic of Ireland (O'Donoghue, 2010). Tree nesting has not been recorded in Northern Ireland in recent years (Ruddock et al., 2008; Hayhow et al., 2013). Harriers will often nest in rides (typically in heather) between plantation blocks or in lacunas within mature plantations where there is a suitable dense growth of mature heather or scrub (Ruddock et al., 2012).

Foraging habitat during the breeding season

Wilson et al. (2009) noted that Hen Harriers in Ireland show a preference for nesting in pre-thicket forest habitats. However observations of foraging behaviour (Madders, 2003a; O'Donoghue, 2012) and pellet analysis of breeding pairs, including those in forested landscapes, show that Hen Harriers also use open heath, scrub and farmland habitats for foraging during the breeding season (O'Donoghue, 2010). In Scotland, Madders (2003a) showed that young forests can be profitable for foraging Hen Harriers due to the combination of prolific ground vegetation and small trees that support large numbers of voles and song birds that the harriers can closely approach without detection.

In Ireland the diet of Hen Harrier is more restricted than that of birds in Britain due to the absence and/or sparse distribution of some small mammal prey species. Therefore comparisons between Ireland and elsewhere need to be undertaken with caution. However

there are substantial amounts of Irish-based evidence that show both first rotation and second rotation pre-thicket forestry are used by foraging Hen Harrier.

- Based on the 2005 national survey data Barton et al. (2006) found that foraging adult Hen Harriers did not use habitats in proportion to their availability and indicated that both first and second rotation pre-thicket plantations were selected for foraging during the breeding season.
- Ruddock et al. (2012) found that almost 40% of all foraging events observed by surveyors recorded as part of the 2010 survey were associated with pre-thicket forests.
- In a study of Hen Harrier in the Duhallow region of north County Cork and east County Kerry, O'Donoghue (2012) recorded that almost 25% of all foraging flightlines observed were in pre-thicket forest.
- Using remote tracking technology Irwin et al. (2012) corroborated the findings of previous studies and determined that Hen Harriers foraging within forested habitats showed a preference for second rotation pre-thicket forest, particularly between 6 - 11 years of age with reduced use of forest between 12 – 15 years old.

Almost equal to the attractiveness of pre-thicket forest to foraging Hen Harriers is its aversion to foraging over mature forests. Post-thicket or mature forest is generally avoided by Hen Harriers for hunting (Madders, 2000; O'Donoghue, 2004). Madders (2003a) notes that as trees mature the harriers may be forced to fly at greater heights subsequently impairing the birds' ability to detect and catch their prey. Barton et al. (2006) analysed foraging habitat data recorded during the 2005 survey which indicated that post thicket forests were not favoured. Irwin et al. (2012) noted that foraging harriers appear to avoid forest stands less than 3 years and greater than 15 years of age.

Although differences between surveys and analyses exist, it can be broadly stated for non-forested habitats within the Hen Harrier breeding range that heath bog, low intensively farmed grassland with well-established hedgerows and areas of scrub are the main habitats used by foraging harriers (Irwin et al., 2012, O'Donoghue, 2012). Indeed in an analysis of the 2010 national survey data Ruddock et al. (2012) calculated that foraging was recorded most frequently over heather moorland and that when habitats were categorised into forested and non-forested habitats it was noted that foraging over forested habitats was observed less frequently (i.e. 43% of the total foraging records) when compared to the non-forested habitats. However a similar analyses on the 2005 surveys shows that forested habitats accounted for 53% of the total foraging records (Barton et al., 2006). This may be a reflection on the progressing maturity of the overall forest estate in these areas between national surveys.

Based on an analysis of foraging spatial data derived from the remote tracking of three individuals from one study site (The Ballyhouras) the following information is of relevance (from Irwin et al., 2012):

- The study birds made greater use of forest habitats than non-forest habitats for foraging. This may be explained by the greater availability of the former habitat in the area around nest sites. These were all located in second rotation pre-thicket forests and surrounded mainly by this and other forest habitats.
- The maximum distance travelled from the nest was 7.5 km (female) and 11.4 km (male), which are significantly further than the estimates for Scottish breeding birds; 2.5km (female) and 9km (male) (Arroyo et al., 2009). More recent research in Scotland corroborates these differences (Arroyo et al., 2014). This may be due to Irish Hen Harriers breeding in forested landscapes having to forage over larger areas in order to provision their broods (at least in the Ballyhouras).

Direct disturbance at the nest site

Adult birds begin to occupy breeding areas in the uplands during March with a view to form pair bonds and to begin nesting. In a two year study O'Donoghue (2010) recorded that eggs were laid as early as the 16th of April and as late as the 10th of June with the median occurring in the first week of May. Incubation per egg is estimated to last 29 – 31 days (del Hoyo et al., 1992). O'Donoghue (2010) noted that the date when chicks fledged ranged from the 18-24th of June to the week of 6-12th of August with the fledging peak occurring during the 9th to the 22nd of July.

A disturbance event which causes the incubating female to flee the nest or which deters the return of provisioning parents can expose eggs and chicks to cold, rain or lack of food (Hamerstrom 1969; Scharf & Balfour 1971; Picozzi 1980). Mammalian predators may follow tracks in vegetation and respond to human scent along trails (Whelan et al., 1994) and may be attracted to nests by visual cues such as presence of humans, trampling of vegetation, increased activity of parent birds in response to disturbance events and by olfactory cues (Skagen et al. 1999).

The Forest Service's AAP Information Note (2012) identifies various forestry related operations which have the potential to disturb nesting Hen Harrier:

- timber felling (thinning, clearfell);
- timber extraction to roadside;
- timber loading at roadside;
- mechanical cultivation for both afforestation and reforestation;
- forest road construction (and associated developments);
- the driving of fencing posts; and
- any other operation(s) the Forest Service may deem as creating disturbance.

Edge effects and susceptibility to predation

Forests can potentially interact indirectly on Hen Harriers over a much wider area due to habitat fragmentation and associated 'edge effects'. Edge effects may extend several hundred

metres from forest boundaries (Stroud et al., 1990; Wilson et al., 2014). For example, forest habitats may act as reservoirs of predators that prey on the ground-nesting birds in the surrounding area (Andren, 1994; Batary & Balde, 2004; Mazgajski & Rejt, 2005) with proven negative edge effects of predation on ground nests close to forest edges (Manolis et al., 2002). These effects are usually driven by nest predators such as corvids (Andren, 1992), Fox (Kurki et al., 1998; McMillan, 2014), Mink (Padyšáková et al., 2009) and Pine Marten (Caryl, 2008) which typically persist at higher abundances in fragmented landscapes and may show behavioural associations with habitat edges (Andren, 1995; Cervinka et al., 2011).

A number of studies also demonstrate that the probability of predator occurrence tends to decrease with increasing distance from forest edges and that predators prefer smaller forest fragments (Chalfoun et al., 2002; Cervinka et al., 2011).

Since land use within and bordering Hen Harrier SPAs are comprised of mosaics of agricultural land holdings, delineated by hedgerows and connected to forest parcels and open moorland there may exist a high potential for emigration of predators from forest areas into and out of adjacent agricultural land holdings and into other habitats connected to them by linear features (Reino et al., 2010). Over the period 2009-12 McMillan (2014) studied the success rates of nesting Hen Harriers on Skye in Scotland where he attributed 65% of the recorded nest failures to Fox predation.

In a study of breeding Hen Harrier in Kerry, West Clare, Ballyhoura Mountains and the Slieve Aughties, O'Donoghue, (2010) found that the predation rate of nesting Hen Harriers in Ireland was higher than that found in any other study of predation rates in Harrier species. The main cause of breeding failure was identified as nest predation, accounting for over half (55%) of all nest failures. Irwin et al., (2011) speculated there may be an association of large-scale afforestation with an increase in abundance of nest predators such as Pine Martens and Fox in Hen Harrier breeding areas.

Disturbance outside the breeding season

Birds frequent roost sites outside the breeding season (broadly defined as mid-August to mid-March) probably for shelter and protection (O'Donoghue, 2010). Roosts serve as bases for the Hen Harriers to radiate out and forage in the local landscape (O'Donoghue 2010). Currently two SPAs are listed for non-breeding Hen Harrier and based on the published data available the majority of the known roost sites occur outside of the SPA Network (Appendix 1 and Figure 3). O'Donoghue (2010) did not record any roost sites in coniferous plantations and even in areas where conifer plantations existed adjacent to roosts (<10% of records as per Figure 6.2 of O'Donoghue (2010)) the harriers chose more open habitat to roost in. More recent data suggest that forest habitats (including failed forests) could equate to approximately 6% of known roosts (B. O'Donoghue, pers comm). Although forestry related activities may potentially cause disturbance events at a small number of known roosts, the main threats and pressures on Hen Harriers at winter roost sites have been identified to be predominantly non-forest related. These include: agricultural reclamation (roost and habitat loss); timing of cultivation practices such as ploughing and spraying (reduction in prey

availability); renewable wind energy development (displacement and disturbance); and human disturbance (NPWS, 2013a). The secondary interactions of forests with Hen Harrier roost sites through increased predation risk and associated edge effects is poorly understood at present.

Foraging habitat outside the breeding season

Passerine bird species were identified to be a frequently recorded prey item in the winter diet of Hen Harriers (see O'Donoghue, 2004; 2010). However the diet did vary geographically with more wading birds and small mammals recorded in Hen Harrier diet associated with the lowlands of southern and eastern areas (O'Donoghue 2010).

CHAPTER 3: POTENTIAL POPULATION LEVEL IMPACTS OF FORESTRY RELATED ACTIVITIES ON THE HEN HARRIER IN IRELAND

Introduction

This chapter builds on the description of the overlaps and potential interactions between forests, their management and the ecology of Hen Harrier. This examination into the potential population level impacts on Hen Harrier by the forestry sector in Ireland is framed by quantifying the spatial and temporal extent of these interactions.

Habitat alteration and loss relevant to the breeding season

O'Flynn (1983) attributes the revival of the Hen Harrier breeding population from the 1950s to the 1970s to the sudden change of habitat caused by the then-afforestation policy which increased the extent of the structurally-diverse, ground vegetation (heather, bramble and gorse) associated with pre-thicket forest and which provided a '*formidable obstacle to potential predators of breeding harriers such as foxes, badgers and humans.*' However Watson (1977) comments that although Ruttledge (1966) stressed that Hen Harriers in Ireland showed a marked preference for afforested areas other experienced observers found that nesting sites on moorland, near forest plantations, were commonest in some districts.

Of the nest locations recorded as part of the first two national surveys Wilson et al. (2009) found over 90% of total were located in four main habitats:

- pre-thicket first rotation plantations (40% in 2000; 16.2% in 2005)
- pre-thicket second rotation plantations (17.5% in 2000; 32.3% in 2005)
- post-closure plantations (primarily including ridelines, patches of poor growth, windtrhow etc: 22.5% in 2000; 22.1% in 2005), and
- heath / bog (11.3% in 2000; 22.1% in 2005)

Similar results were noted from the 2010 survey where 9% and 43% of nests located were recorded in first and second rotation pre-thicket habitats respectively (Ruddock et al., 2012). In Northern Ireland, a study of Hen Harriers during 2006 and 2007 recorded that of the nest sites for which habitats were known, 44% were in pre-thicket forest. Ninety-six percent of this pre-thicket forest was aged between two to six years of age, all of which was second rotation (Ruddock et al., 2008). Pre-thicket forest is only useful to nesting Harriers for six to 10 years out of investment cycles of 40 – 60 years or more (dependant on species and soil productivity category). Over the years a significant portion of Ireland's peat based habitats have been afforested and/or experienced other pressures (e.g. burning, overgrazing) that reduced their overall conservation value (Wilson et al., 2012b; NPWS 2013b). The selection of forest habitat by Hen Harrier during the breeding season may be an artefact of such past and continuing pressures.

Table 2 sets out the estimated extent of pre-thicket forest which constitutes a potential nesting resource for Hen Harrier over time in the SPA network. The retrospective and projected extent of usable pre-thicket was based on the assumption that no additional afforestation will occur in the SPAs and considers all pre-thicket forest between 1-12 years as potential nesting habitat (first and second and subsequent rotation ages). This analysis also assumes that all forest will be replanted like for like after its full investment cycle (midrange values of 42 years for Sitka Spruce based on Lekwadi et al 2012; and 60 years for larches and pine species based on Horgan et al 2003) following a default period of 3 years clear fell prior to replanting. It is acknowledged that 'like for like replanting' may not happen in all cases as the implementation of setback areas and forest edge re-profiling may occur.

Table 2 The estimated extent of forest within the SPA Network that is potentially useable as Hen Harrier nesting habitat for the period 2000 - 2045

	2000		2012		2025		2035		2045	
Special Protection Area	Area (ha)	% of forest	Area (ha)	% of forest	Area (ha)	% of forest	Area (ha)	% of forest	Area (ha)	% of forest
Mullaghanish to Musheramore Mountains 004162 (4975.6ha)	648	**52**	371	**22**	116	**7**	298	**17**	670	**39**
Slieve Aughty Mountains 004168 (59435.65ha)	12773	**51**	5743	**18**	3751	**12**	4098	**13**	11663	**36**
Slieve Beagh 004167 (3455ha)	602	**62**	660	**41**	116	**7**	158	**10**	456	**28**
Slieve Bloom Mountains 004160 (21761.25ha)	4476	**44**	3430	**25**	1276	**9**	2016	**15**	4174	**30**
Slievefelim to Silvermines Mountains 004165 (20909ha)	5026	**59**	2609	**23**	1211	**11**	1579	**14**	4944	**44**
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle 004161 (56627.2ha)	11940	**54**	4950	**17**	3745	**13**	5016	**17**	10666	**4950**
Total	35465	**52**	17763	**20**	10216	**11**	13164	**15**	32573	**37**

Based on these estimates it is projected for the period 2012 – 2025 that all SPAs will undergo an acute reduction in the extent of forest that is of use to the Hen Harrier as a nesting resource. The overall decline is estimated to be 42% for this period when only 11% of the entire forest estate in the SPA network will constitute a potential nesting resource for forest

nesting Hen Harrier. The projected decline of this resource varies between the SPAs from approximately 24% (Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA) to 82% in Slieve Beagh SPA. Accordingly it will likely be after 2035 (Table 1) before the net estimated usable forest nesting habitat will exceed present levels.

Although nesting in pre-thicket forests was recorded more frequently than in heath during the last national survey (Ruddock et al., 2012), heath is considered to be more stable as it is not subject to the degree of structural change associated with the forest maturation process.

As outlined in the previous chapter the Hen Harrier in Ireland makes extensive use of both first and second rotation pre-thicket forest habitat during the breeding period. However by its successional nature forests inevitably matures and become less suitable (Avery & Leslie, 1990; Madders, 2000; 2003; O'Donoghue, 2004).

Haworth and Fielding (2009) noted that forests supported a significant proportion of the Hen Harrier breeding population of western Scotland. Based on more recent information Hayhow et al. (2013) reported significant declines in the number of Hen Harriers breeding within forest plantations in a number of biogeographical regions of Scotland (55% and 74% for young and mature plantations respectively). Several years earlier and based on the knowledge that the extent of first rotation pre-thicket in Argyll, west Scotland was in decline Madders (2000) predicted that a decline in pre-thicket forest would lead to a reduction in breeding Hen Harrier numbers in west Scotland. Hayhow et al. (2013) reports that the breeding population declined by over 17% in the West Highlands of Scotland during the period 2004 – 2010.

Forests less than 15 years old constitute to varying degrees a potential foraging resource for Hen Harriers. In line with the forecasted reduction in the extent of the forest nesting resource, indicative future estimates of the extent of the potential forest foraging resource within the SPA network shows an acute declining trend over the next 10 years (Table 3). The same assumptions which applied to the estimation of the potential nesting resource also applies here except that all pre-thicket up to and including pre-thicket stands of 14 years was used.

An overall decline of some 36% in the predicted extent of forests of a suitable age to be of use for foraging Hen Harriers is estimated for the period 2012 to 2025. This decline varies between the SPAs from approximately 24% (Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA) to 82% in Slieve Beagh SPA. Future estimates of forest age structure in SPAs show that the extent of this resource present prior to the Hen Harrier SPA population decline observed between 2005 and 2010 will not be equalled in the next 20 years (Table 3). Greater spatial detail of the estimated projections per SPA is given in Appendix 3.

Table 3 The estimated extent of forest within the SPA Network that is potentially useable as Hen Harrier foraging habitat for the period 2000 - 2045

	2000		2012		2025		2035		2045	
Special Protection Area	Area (ha)	% of forest	Area (ha)	% of forest	Area (ha)	% of forest	Area (ha)	% of forest	Area (ha)	% of forest
Mullaghanish to Musheramore Mountains 004162 (4975.6ha)	783	63.11	510	30	295	17	568	33	878	51
Slieve Aughty Mountains 004168 (59435.65ha)	14197	56.15	7945	25	5710	18	7147	22	15804	49
Slieve Beagh 004167 (3455ha)	648	66.62	815	51	145	9	226	14	720	45
Slieve Bloom Mountains 004160 (21761.25ha)	5107	50.08	4045	29	2363	17	3414	25	6287	46
Slievefelim to Silvermines Mountains 004165 (20909ha)	5566	65.60	3119	28	1740	16	3483	31	5840	52
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle 004161 (56627.2ha)	13270	59.92	7261	25	5549	19	8499	30	13857	48
Total	39572	**57.9**	23695	**27**	15082	**18**	23337	**26**	43387	**49**

Analysing Hen Harrier breeding population trends along with changes in forest cover and suitability

Based on data derived from the 2000 and 2005 national surveys Wilson et al (2009) found no evidence that the area of post-closure plantations, within a 2km radius of the nest site, negatively affected Hen Harrier nest distribution. Also it was noted that there was a positive correlation across study areas between changes in numbers of Hen Harrier nests between 2000 and 2005 and changes in the area of pre-thicket second rotation plantations over the same period.

Ruddock et al. (2012) reporting on the most recent national survey undertaken in 2010, suggested that forest maturation may be partly responsible for observed regional decreases in breeding Hen Harriers. To explore the relationship between forest cover, forest suitability and Hen Harrier density over time, a comparison of territorial pairs of Hen Harrier within several regional areas was undertaken using spatial data from the first national survey in 1998-2000

(Norriss et al., 2002) and third national survey in 2010 (Ruddock et al., 2012). These regions were defined by clusters of overlapping territorial pairs located within 8km of each other (representing a median distance between core and most outward foraging extent (see Irwin et al., 2012). A 2km buffer zone (core foraging area) was applied to all territory centres in each discrete cluster and merged to form "regional zones". This approach to defining these important areas differs to some degree from the formal SPA designation process and is specific only to the purposes of this review. Given the importance of SPAs for breeding Hen Harrier, it is no surprise that there is significant overlap with these regional zones (as defined by Hen Harrier territory data) and corresponding SPA boundaries. However seven regions occur outside the current SPA network (Figure 6).

The results of this comparison are outlined in Table 4. The regional zones with the four most important breeding populations in Ireland were the subject of this comparison; the Slieve Aughty Mountains; Slieve Bloom Mountains; Slievefelim Mountains; and the South Stacks Complex. These four areas comprised 56-66% and 47-48% of the total breeding population in 1998-2000 and 2010 respectively. Table 4 includes minimum and maximum percentage values for forest cover suitable for Hen Harrier. This is due to some forest compartments in the Forest Service inventory being of unknown forest growth stage or planting year.

Table 4 Changes in forest cover and suitability in relation to breeding Hen Harriers territories between 2000 and 2010

Regional Zone or Study Area	Decline in Hen Harrier Density	Increase in Forest Cover	Decline in forest suitability for Hen Harrier (min-max)
Slieve Aughties (49,911ha)	19%	26%	38 - 40%
Slieve Blooms (21,111ha)	18%	27%	36 - 37%
Slievefelim to Silvermines (27,938ha)	66%	26%	48 - 49%
Stacks Complex (South) (32,570ha)	69%	24%	46%

It is important to note that this exercise merely documents three variables (i.e. changes in Hen Harrier density, changes in forest cover and changes in the extent of forests habitat that is potentially available to breeding Hen Harriers). Therefore cause and effect is not proven and indeed other potential variables are not included in the analyses (e.g. rates of agricultural intensification, land abandonment, wind farm development). However as forestry is the dominant sectoral pressure in these areas these broad correlations are noteworthy. Table 4 shows that in the four most important regions supporting breeding Hen Harrier in 2000, the subsequent population decline at these areas, ranging from 19 to 69%, coincided with decreases in the overall extent of forests of an age that represented a breeding resource for Hen Harrier. It is also noteworthy that the overall footprint of forest through afforestation

increased significantly during this period of population decline (further detail of this analysis is presented in Appendix 3).

Potential interactions of forestry and Hen Harrier populations outside of SPAs

The analysis of potentially usable forestry as shown in Table 2 and Table 3 do not consider known Hen Harrier breeding areas outside of the Hen Harrier SPA network. It is likely that some sites within the 'wider countryside' areas supporting breeding Hen Harrier that have been afforested will also experience forestry related changes both due to the maturation of existing forest habitat and the conversion of currently useful habitat (e.g. scrub, low intensity managed farmland) to a less stable state. Based on the methodology previously described using 2010 survey data (Ruddock et al., 2012) fifteen distinct important regions for Hen Harrier during the breeding season were identified. Although eight of these areas overlap existing SPA boundaries the remaining seven are not part of the Hen Harrier SPA Network (Figure 6).

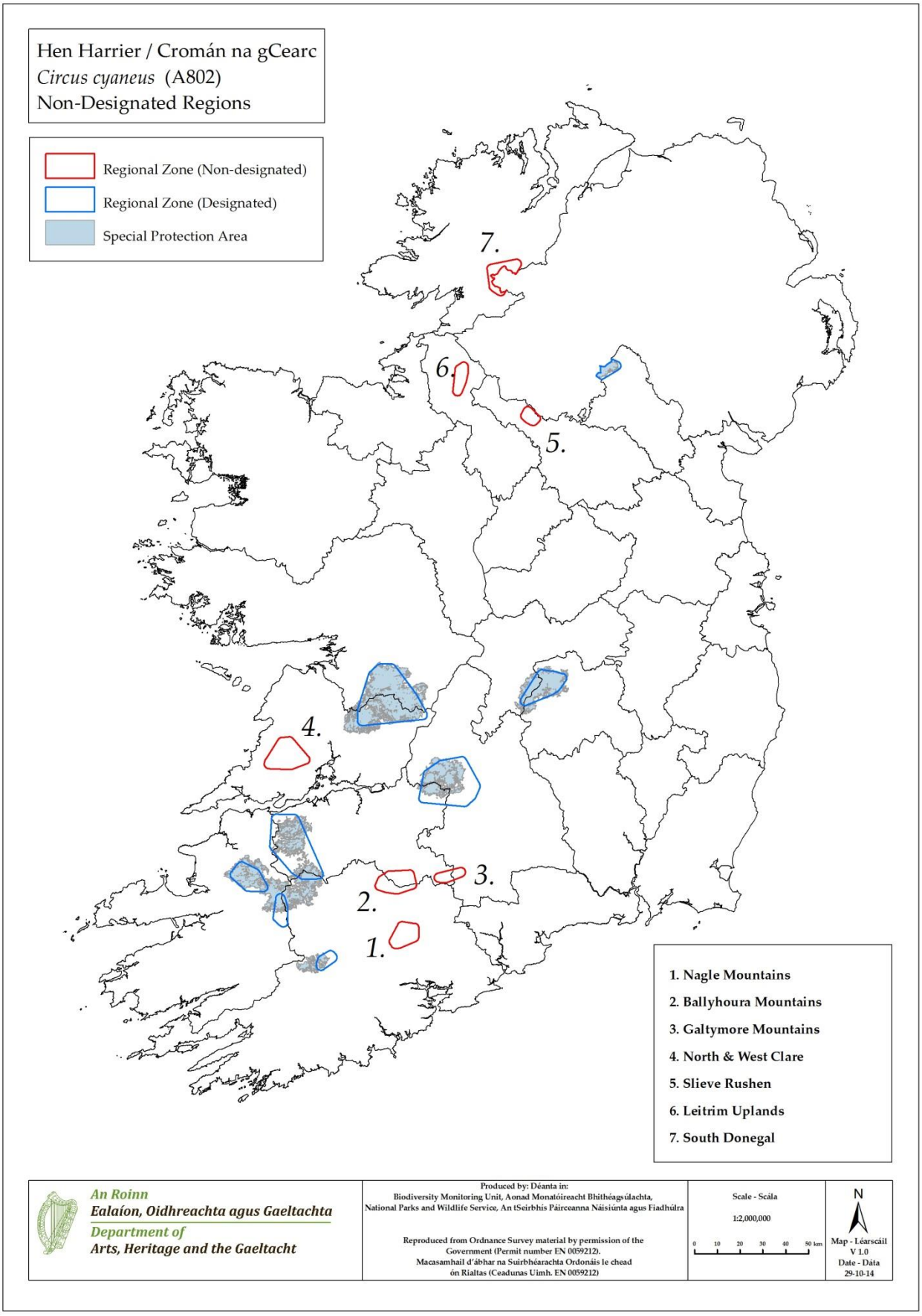

Figure 6 Regionally important areas for Hen Harrier outside of the SPA Network (based on the 2010 national survey).

When these seven areas are overlaid with the Indicative Forest Strategy Map of Ireland (DAFM, 2008) that categorises land in terms of its suitability for further afforestation it is estimated that 46% of the total area is currently regarded as being suitable for a range of forest types or for certain types of forest development and that 58% is currently regarded as potentially suitable for some form of forestry (see Table 5 below).

Table 5 The overlap of the Forest Strategy Indicative map with the seven important non-designated Hen Harrier areas

Category	Approximate % overlap with wider country - important breeding areas 2010
Suitable for a range of forest types	14%
Suitable for certain types of forest development	32%
Suitable, where appropriate, for nature conservation and/or amenity forests	12%
Unsuitable, unproductive or unplantable areas	42%

Other factors influencing the impact of forests on Hen Harrier conservation

Quantifying the negative impact of an overall net loss in the availability of breeding habitat due to forest maturation on a Hen Harrier population can be influenced by several factors. Although O'Donoghue (2010) found that the size of forest stands occupied by harriers and size of adjacent forest stands did not differ significantly across study areas, the net extent of suitably aged pre-thicket forest within an SPA or important area provides a useful measure of the amount of forest related foraging habitat that is currently used or potentially of use by Hen Harrier. However the size, location, quality and context of such discrete areas may have an influence on the value of a particular pre-thicket plantation for breeding Hen Harrier. Small, isolated coups of pre-thicket forest surrounded by mature (currently unusable) forest may not contribute positively and proportionately to the overall sites' conservation condition. Since provisioning Hen Harriers have been shown to forage greater distances in forested landscapes in Ireland compared to studies from other countries (Arroyo, 2006; Irwin et al., 2012; Arroyo et al, 2014), habitat connectivity is likely to be an important consideration in forest management for Hen Harriers in Ireland.

Although prey delivery rates during an Irish study (0.77 item h^{-1}) were 'similar or at the lower end of the scale' when compared to studies outside of Ireland (O'Donoghue 2010) some sites were provisioned less frequently than others (i.e. the Ballyhouras). Irwin et al. (2012) found that the difference may be because the harriers had to forage over larger areas in order to provision their broods. Reduced potential prey arising from poor weather and/or biogeographic constraints may have been a factor in these results but spending increased amounts of time away from the nest may potentially lead to an increase in chick starvation

and/or predation rates. The cause of these relatively extended provisioning trips could well be due to:

- *Habitat fragmentation* – provisioning Hen Harriers nesting in landscapes with high proportions of mature closed canopy forestry that offer little foraging value, will have to increase their foraging range to meet the nutritional demands of the growing chicks and the adults themselves.
- *Connectivity to permanently open habitat* – if foraging harriers are more profitable in open or moorland habitats they may have to travel over large expanses of mature forests to access these habitats possibly increasing foraging time, energetic expenditure and range (see Ruddock et al., 2008).
- *Reduced habitat quality/extent* – second rotation pre-thicket areas are thought to be used for a shorter length of time when compared to first rotation pre-thicket (up to 10 years and up to 12 years respectively (Wilson et al., 2009 but see Irwin et al 2012). In landscapes with a higher proportion of second rotation to first rotation pre-thicket, the availability of the potential forest foraging and nesting resource for Hen Harrier will be even more limited. Possibly the post-clear felling debris (brash) that remains in replanted areas results in fewer prey items or that they are more able to evade capture when compared to first rotation pre-thicket (Wilson et al 2012).

It is established that Hen Harrier productivity rates recorded in Ireland are less than those recorded in Britain (O'Donoghue, 2010). Fielding et al. (2011) noted that the annual productivity rates for Hen Harrier breeding in young conifer forest in Scotland were lower than those estimated for moorland sites that were not subject to grouse management. Irwin et al. (2012) explored the links between Hen Harrier breeding success, forest cover and forest growth stage. Although not observed across all the study sites, the study found a negative association between the extent of second rotation pre-thicket forest and breeding success. Reporting on this study Irwin et al (2012) noted that the data analysed suggest that, at least in some parts of their range, Hen Harrier numbers in Ireland are decreasing and that low levels of breeding success may be a contributing factor in this decline. This data along with long established findings that Hen Harrier actively selects second rotation as nesting habitat led Wilson et al. (2012b) to conclude that in afforested areas in Ireland habitat preference by Hen Harrier does not necessarily reflect habitat quality. This negative association between second rotation forests may be due to sub-optimal levels of food supply in the landscape and/or that the elevated rates of nest loss associated with the forest was due to nest predation or abandonment.

Since Hen Harriers normally make only one nesting attempt each year, predation events reduce annual reproductive success and may therefore over-time contribute to population declines (Fielding et al., 2011). Our current knowledge of differences in predation rates in forested and non-forested landscapes in Ireland is currently poorly understood.

Direct disturbance during the breeding season

In a study which monitored the causes of nest failures (n = 30) forestry operations were considered to have resulted in the failure of at least two nests or 6.6% of the sample (O'Donoghue, 2010). During the 2010 Hen Harrier National Survey disturbance threats to Hen Harriers and suspected causes of nest failure were reported by fieldworkers. Although 'burning of vegetation was the most frequent at 22%, 'forestry operations' were associated with over 10% of the records of failed breeding (Ruddock et al., 2012). Currie and Elliott (1997) and Petty (1998) specifically reviewing and mitigating forestry disturbance in the United Kingdom suggested a buffer of 500 - 1000m and 500 – 600m respectively for Hen Harriers. Ruddock and Whitfield (2007) reviewed the disturbance distances of several bird species including the Hen Harrier. Informed by the literature, some empirical evidence and by expert opinion it was suggested that a buffer of 500 – 750m would apply to Hen Harrier during the breeding season.

Mismatches between breeding success and habitat preferences

In 2005 almost one third of the Hen Harrier nest sites analysed were found in second rotation pre-thicket habitat. As this habitat only accounted for 5% of the total study area shows that this habitat was strongly selected by nesting Hen Harriers (Wilson et al 2009). In the UCC PLANFORBIO Report, Irwin et al (2012) described a negative relationship between second rotation pre-thicket forests and Hen Harrier breeding success at one of their study sites. Wilson (2009) found that Hen Harrier breeding success decreases noticeably when the percentage of second rotation pre-thicket forest in the surrounding landscape is greater than 10%. At least in some parts of their range, Hen Harrier numbers in Ireland are decreasing, low levels of breeding success may be a contributing factor in this decline (Irwin et al 2012).

On this issue Wilson et al (2012a) concludes that the area-specific relationship between breeding success of Hen Harrier and second-rotation prethicket forest habitat serves to illustrate that, especially in anthropogenically altered landscapes, habitat preferences do not necessarily reflect habitat quality. The negative association between second rotation forests may be due to sub-optimal levels of food supply in the landscape and/or that the elevated rates of nest loss associated with the forest was due to nest predation or abandonment.

Potential interactions of forestry outside the breeding season

Habitat loss and disturbance at roost sites

The Irish Winter Hen Harrier Survey (IWHHS) is the main source of survey and monitoring data for Hen Harrier during the non-breeding period in the Republic of Ireland, providing insights into the distribution and occupancy of roosts across the country and has been in operation since 2005. An analysis of the monitoring scheme is planned once the survey completes its tenth year (B. O'Donoghue, pers comm) and would provide greater understanding of the relative importance of the known roost sites for the conservation of this species. Human activities can cause abandonment of Hen Harrier roosts (Clarke & Watson, 1990; O'Donoghue, 2010).

To date the IWHHS has identified 96 confirmed roost sites and a further 13 suspected roost sites. The latter criterion is based on the existence of suitable habitat coupled with anecdotal evidence of site use by Hen Harrier. When the locations of these roost sites are overlaid with the Indicative Forest Strategy Map of Ireland (DAFM, 2008) that categorises land in terms of its suitability for further afforestation it estimated that 35% of these locations are currently regarded as being suitable for a range of forest types or for certain types of forest development and that 73% is currently regarded as potentially suitable for some form of forestry (see Table 6 below).

Table 6 Distribution of known roost sites across the four categories defined by the Indicative Forestry Statement

Category	% occurrence*
Suitable for a range of forest types	20
Suitable for certain types of forest development	15
Suitable, where appropriate, for nature conservation and/or amenity forests	38
Unsuitable, unproductive or unplantable areas	25

*It is acknowledged that due to mapping issues the total percentage overlap set out here does not equate to 100

Loss of foraging outside the breeding period

It is known that a proportion of the overwintering population of Hen Harrier in Ireland either remain on or transiently use the breeding uplands for foraging and roosting, so similar sources of habitat loss that have been identified for the breeding population (e.g. maturation of forests) are relevant here.

Although studies examining foraging habitat preferences of Hen Harriers in Ireland in winter are limited, it is likely that closed canopy forest (actively avoided by foraging Hen Harrier during breeding season) is also of negligible importance for this species outside breeding season.

The pressure caused by maturation of forest blocks on individual Hen Harriers outside the breeding season may be less obvious due to the perceived movement of birds to less exposed and less afforested lowland areas in winter. The magnitude of this pressure may not be as severe because:

- Hen Harrier are more widely distributed (Figure 3) and may be less dependent upon the breeding sites which currently have a relatively high proportion of afforested habitats; and,
- Hen Harrier are known to use a wider variety of non-afforested habitats including tillage during the winter months.

These pressures may be less severe or pronounced outside the breeding season; however, the availability of suitable foraging habitat in heavily forested landscapes may be an important factor in winter survival. Satellite tracking studies in Ireland and United Kingdom have shown that birds will disperse up to 20km from roost sites during the day to forage on upland heath and rough grassland, often returning to the same areas frequently over a period of days, weeks and months (B. O'Donoghue, pers comm; S. Murphy, pers comm). These patterns of dispersal may indicate that the dependence on foraging quality away from roosts in areas of lowland and upland heaths and marginal farmland may be as important for winter survival as they are for reproductive success during the breeding season. These pressures associated with habitat loss and forest maturation are considered relevant because:

- During winter, prey species are less abundant and more widely dispersed; the available hours of daylight in which Hen Harrier can forage are shortened;
- Inclement weather is more prevalent; and,
- The greater energy demands of winter can be exacerbated when foraging resources are limited in the wider landscape.

CHAPTER 4: REDUCING THE RISKS OF NEGATIVE POPULATION LEVEL IMPACTS ON THE HEN HARRIER IN IRELAND DUE TO FORESTRY RELATED ACTIVITIES

Introduction

Drawing from the previous sections this chapter aggregates the various forestry related threats and pressures in relation to the conservation of Hen Harrier in Ireland. Gaps in our understanding are identified and various approaches that would lead to a reduction in the threats to the Hen Harrier in Ireland are also introduced here.

Habitat loss and/or alteration

The recent research findings as reported by Irwin et al. (2012) and Wilson et al. (2012a) raise the possibility that the preference shown for nesting birds for pre-thicket second rotation forestry is, at least in some circumstances disadvantageous for Hen Harrier. If birds actively select second rotation pre-thicket forests to nest and if nesting in such landscapes leads to a depressed breeding success rate due to poorer foraging opportunities and/or increased predation rates then such a mismatch between preferences for and the value of habitats could theoretically become an 'ecological trap' (see Kokko & Sutherland, 2001; Battin, 2004; Wilson et al., 2009). Wilson et al. (2012a) concludes that successfully diagnosing such mismatches would require a detailed understanding of the determinants of habitat quality, and its consequences for individual fitness.

This mismatch or potential ecological trap is a source of significant concern for the long term viability of the Hen Harrier population in the SPA network where approximately 52% of the total area is currently managed for forestry. This may also have wider countryside implications as important non-designated areas are afforested to some degree or are in areas that are currently considered to be suitable for further afforestation. For each SPA reducing the footprint of forestry in strategic zones that would decrease the overall forested area of the SPA would reduce this impact.

There are a number of gaps in our understanding with the conservation management of Hen Harrier in Ireland. No specific scientific literature is available that identifies the optimum forest coupe size and other characteristics that might reduce the vulnerability of Hen Harrier nests to predation in pre-thicket forests. At this moment in time it is not known if the availability of nest sites in pre-thicket forest is a limiting resource in the sense that a reduction in the extent and distribution of this nesting resource will result in a reduction of nesting capacity in Hen Harrier areas.

Since the extent of the pre-thicket forest as a nesting resource in SPAs (i.e. between 1 - 12 years of age) is decreasing (see Appendix 3 and Table 2), forest habitat management measures could be focussed at maintaining the extent and distribution of suitably aged pre-thicket stands within the existing forest estate concomitant to the adoption of a strategy to

improve the extent, quality and connectivity of open habitats important for Hen Harrier (e.g., restoration of forest blocks to heath habitat where practical - for more information see http://www.irishbogrestorationproject.ie/).

Nest sites situated in areas that are relatively more stable through time than pre-thicket forest (e.g. heath bog areas) are potentially more valuable for Hen Harrier conservation. Therefore increasing the extent of the overall non-forest habitats that could provide nest sites for Hen Harrier would represent a more sustainable target.

During the breeding season Hen Harrier requires suitable (both in size and quality) areas of open habitat to forage over. In most instances breeding birds use a combination of more stable open habitat (e.g. heath/bog, rough grassland and scrub) and pre-thicket forested areas to forage over. Due to the maturation and estimated harvest cycles currently envisaged for the SPA Network it is predicted that the pre-thicket forest resource will continue to decline significantly over the next 10 years. The overall extent of this resource as estimated to have existed for the year 2000 is not expected to recur within the SPA network until after 2035. This bottleneck caused by a dominance of mature closed canopy plantation poses a significant pressure which could be compounded through increases in agricultural intensification and wind farm development. Such a net pressure could well lead to further declines within the SPA network both in numbers and distribution. To ameliorate this bottleneck on foraging resources within forests, a reduction in the overall footprint of forestry in SPAs may well be warranted. A detailed analysis on the extent of habitats in the SPA network informed by the Hen Harrier Habitat Mapping Project undertaken as part of the Threat Response Plan process could inform such measures.

Therefore the availability of pre-thicket forest of suitable age (ideally 1-12 years but also to a lesser extent 13 – 14 years) within the existing forest footprint at both the SPA site and sub-site level should be optimised with a view to avoiding further future potential bottlenecks of mature forest in breeding areas.

Areas of Biodiversity Enhancement (ABEs) currently may mitigate to some degree the impacts of maturing first rotation forests in the Hen Harrier SPAs. It would be useful if such measures were reviewed with a view to improving their efficacy and ideally extending Hen Harrier specific ABEs to other non-designated areas that are of importance for breeding Hen Harrier.

Wilson et al. (2012a) speculates that the post-clear felling debris occupying some second rotation pre-thicket areas may inhibit the foraging efficacy of Hen Harriers but specific research on this or indeed the feasibility of restoring once afforested areas to more stable habitats for Hen Harrier has not yet been undertaken.

Due to the noted relationship with decreased Hen Harrier breeding success and second rotation forest (Irwin et al., 2012), the risk of negative population level impacts is likely to be heightened in a landscape dominated by second and subsequent rotation forest.

Wilson et al. (2012b) examined the impact of afforestation trends on bird conservation and noted that the recent dominance of gley soils among afforested mineral soils indicated that wet grassland habitats sites are being afforested more commonly than improved grassland habitats. Heath bog and non-intensively farmed grasslands are important and relatively stable habitats for Hen Harriers. The fact that 55% of the 2010 breeding Hen Harrier population occurred outside of the six breeding Hen Harrier SPAs, a proportion that is likely to increase in the immediate future should breeding populations in some SPAs continue to decline, places proportionally greater conservation importance on such areas. The value of these wider countryside areas of known importance to Hen Harrier conservation is twofold:

- a species with a wider breeding range has a national population that is likely to be more robust to pressures acting at a site level; and,
- it is possible that due to the maturation of the forest estate in combination with other pressures occurring in SPAs that for some sites at least, the breeding population may drop below a critical level – a sufficiently large and persistent population outside of the network could improve the re-colonisation potential for those SPAs that are at risk of local extinctions.

Data is limited on the population level impacts of afforestation and forest maturation on Hen Harriers in Ireland outside the breeding season through the loss of potential foraging habitat. How such activities are likely to impact on the attendance rates of individuals at roost sites is poorly understood. If the overall suitability of roost sites is influenced to some degree on the foraging value of the immediate hinterlands, then widespread afforestation of areas ecologically linked to these sites that eventually leads to a closed canopy landscape may negativity impact on the roost attendance rates. On balance this pressure is considered at this moment to be less than those pressures already identified for the breeding period. However more published research on the ecology of Hen Harrier during the overwintering period would be useful to bring more certainty to this issue.

Direct disturbance

Research indicates (see O'Donoghue, 2010) that forestry operations can cause nest failure events. With the proportion of breeding birds occurring outside the network increasing from 39% in 2005 to 55% in 2010 (Ruddock et al., 2012) there is an increasing risk that more Hen Harrier nests may be impacted by forestry related activities in the future. Forest Service Red Areas have been in operation within SPAs for a number of years. This approach is a positive way of minimising the risk of nest failures due to forestry related activities within the SPAs. The location and distribution of nesting Hen Harrier can vary between years. Nest site distribution is likely to change in response to changing forest structure in heavily forested landscapes. As the current Red Areas are largely based on data collected during the period 2005 – 10 these zones become more outdated as the years progress. Revising these zones based on updated data in the future and extending this approach to other areas outside of the

SPA network that are of importance to breeding Hen Harrier would reduce the risk of this pressure.

Thirty-five per cent of known and suspected Hen Harrier roosts occur in areas categorised by DAFM (2008) as "suitable for a range of forest types" or "suitable for certain types of forest development." O'Donoghue's (2010) considers that over 30% of the known roosts are under threat from afforestation. Without further research it is unclear how the population dynamics of Hen Harrier in Ireland would be impacted by the loss of these roost sites to afforestation but it would be prudent to extend a relatively high level of protection to such sites. Contemporary information on the overlap of roost sites and proposed afforestation would help quantify the likely overlap. Afforestation screening assessments would benefit by being informed by known Hen Harrier roost data.

Note on Afforestation

Breeding Hen Harriers can make use of first rotation pre-thicket forestry as both a nesting and a foraging resource. However such areas become largely unusable as breeding habitat after approximately 12 years. Furthermore it is likely that such afforested areas will be restocked overtime thus eventually contributing to the extent of the second rotation pre-thicket forested landscape within these Hen Harrier breeding areas. Hen Harrier breeding success decreases noticeably when the percentage of second rotation pre-thicket forest in the surrounding landscape is greater than 10% (Wilson et al 2012). Therefore further afforestation is not considered to be part of the overall suite of positive conservation options which are detailed in the following chapter.

CHAPTER 5: CONSERVATION MANAGEMENT OPTIONS

Introduction

This final chapter sets out a series of options in relation to the conservation management of the Irish Hen Harrier population that are relevant to the Forestry Sector that could be developed and integrated into the overall Hen Harrier Threat Response Plan.

As previously mentioned Wilson et al (2012) found that Hen Harrier breeding success can decrease noticeably when the percentage of second rotation pre-thicket forest in the surrounding landscape is greater than 10%. On this point Irwin et al (2012) sets out that '*In a forest landscape with a well-balanced age-structure, approximately one quarter of the forest estate will be in pre-thicket stage at any one time. A maximum threshold of 40% for total forest cover in the landscape would therefore ensure that the percentage of pre-thicket forest did not regularly exceed 10%.'*

The forestry estate accounts for approximately 52% of the total forest cover across the breeding Hen Harrier SPA Network. Furthermore it is evident that the existing forest estate within the SPA Network is not well balanced (see Table 2 and Table 3). Addressing these two issues is central to the successful implementation of the Hen Harrier Threat Response Plan. It therefore follows that both the short and longer term activities of the Forestry Sector operate within the ecological parameters that are necessary for the long-term conservation of the Irish Hen Harrier population.

In terms of effectively increasing both the quality and extent of breeding Hen Harrier habitat in Ireland the Forestry Sector cannot operate in isolation. The timing and extent to which these forest related options presented below are taken up can be positively influenced by other relevant stakeholders, in particular the Agricultural Sector by undertaking other Hen Harrier conservation measures. Such measures will be detailed in further publications.

Optimising the extent of breeding habitat in the SPAs

An appropriate long term temporospatial forest management strategy for each of the six SPAs is required. This would significantly reduce the impact of the closed canopy forest bottleneck as well as reducing the risks of depressed breeding productivity rates. The two primary pillars of such a strategy would be:

- For each SPA the extent of pre-thicket forest habitat (ideally < 12 years of age) as a proportion of the total forest footprint should be optimised at relevant scales. Various methods could be explored to achieve this including premature felling, delayed replanting etc.
- Informed by the Habitat Mapping Project and other relevant sources identify forested areas (e.g. where the percentage of pre-thicket forests in the surrounding landscape would be projected to exceed 10%) that if converted to more permanent Hen Harrier

(e.g. heath/bog) habitat would significantly improve the conservation value of the wider area in terms optimising the long-term foraging resource whilst lessening the negative impact of forestry on breeding productivity rates. Such areas (including forest habitat of poor to low productivity) need to be restored to suitable heath bog habitat. Clear felled areas not subject to appropriate restoration and maintenance actions may well be of some use to Hen Harriers in the short term. However such areas are liable to eventually become unsuitable as vegetation succeeds to denser scrub/woodland habitat.

Targets relating to achieving a reduction in the forest demographic bottleneck and targets relating to the successful conversion of forestry to more permanent Hen Harrier habitat could be agreed through the TRP process and set for five yearly intervals. This would enable stakeholders to chart progress and to adapt the targets if necessary based on updated data from other sources (e.g. possible future update of the SPA Habitat Mapping Project).

Managing the quality of forest habitat in the SPAs of use to breeding Hen Harrier

Closely integrated with the above and in order to improve the availability of the prey resource, to reduce the risks of nest predation and to minimise any forestry related disturbance during the breeding season the following options should be progressed.

- The management prescriptions contained within the existing Areas of Biodiversity Enhancement programme could be reviewed and their efficacy for improving Hen Harrier breeding habitat refined. Such measures could then be promoted for uptake in those areas earmarked for replanting within the SPAs. Some options within the proposed Forestry Programme 2014-2020 Woodland Improvement Scheme could possibly be relevant here.
- Informed by further research if necessary produce prescriptions for managing the post clear-fell/ replanting of coups so that their value as a foraging resource for Hen Harrier be optimised (e.g. removing debris).
- The association of predators with forestry both at the individual forest and afforested landscape level and their impact on ground nesting bird populations is a significant knowledge gap. Undertaking research on this topic with a view to defining:
    - optimum habitats to significantly reduce ground nesting birds' vulnerability to predators; and
    - effective levels of direct predator control effort at relevant scales

  would inform the development of sustainable forest management approaches in these areas over the medium to long term.
- To continue to minimise the impacts of forestry related disturbance operations in sensitive breeding areas the Forest Service's Red Area procedure could be reviewed and revised. Elements of this revision should include an updating of the associated mapped areas informed by the results of the next national Hen Harrier Survey (due in 2015). Additionally extending the list the list of disturbance operations to specifically include manual planting could also be considered.

Wider Countryside Breeding Season Measures

Based on 2005 survey data, the SPA network supported over 60% of the national population of breeding Hen Harrier (Barton et al., 2006). Our current knowledge shows that the majority of breeding birds (based on the 2010 survey) now occur outside of the network with the consequence that the 'Wider Countryside' element is increasingly more relevant to the conservation of this species at the national scale. Relevant recommendations to decrease the population level risk related arising from forestry related activities (and primarily targeted at the important areas identified through national surveys) could include:

- extending a Hen Harrier specific ABE set of options to include non-designated but important Hen Harrier breeding areas;
- adapting the Red Area approach to develop measures to reduce disturbance to nesting Hen Harriers potentially caused by forestry related activities;
- undertaking measures to reduce the impact of any potential ecological traps/mismatches in non-designated but important Hen Harrier breeding areas by increasing the size and improving the quality of clear-felled coups for breeding Hen Harrier; and
- carrying out an assessment of the extent of forests and Hen Harrier habitat in non-designated but important Hen Harrier breeding areas, and developing if appropriate, regional afforestation thresholds to avoid significant long-term impacts on Hen Harriers and their prey species.

Wider Countryside Non-breeding Season Measures

- The likely extent of proposed afforestation on winter roosts should be quantified and planting at such sites should be avoided; and,
- Increasing our knowledge of the ecology and population dynamics of Hen Harrier during the non-breeding/overwintering period through further research would inform the scale of assessment required when examining the potential impacts of afforestation on overwinter foraging resources.

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