Northern Ireland Hare Survey 2008

Prepared for

Environment & Heritage Service

by

Neil Reid, Marc Ruddock,

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On 1st July 2008, Environment & Heritage Service

became the Northern Ireland Environment Agency.

Executive Summary

1. The Northern Ireland Irish hare survey was undertaken during spring 2008 and compared to surveys undertaken from 2002 to 2007. Standardised field survey methods and analytical techniques were employed to enable direct between-year comparisons enabling relative change in hare density to be evaluated.

2. Using conventional analysis the mean estimated Irish hare density in Northern Ireland during early 2008 was 2.86 hares.km^{-2} (95% CI 2.16-3.79), giving a total estimated abundance of 40,500 hares (95% CI 30,600-53,700).

3. Estimated hare density during 2008 was lower than during 2007 but the 95% confidence intervals of both estimates overlapped substantially. Therefore, there has been no significant change in the hare population since 2007.

4. We make the 3 recommendations for action:

   a. Regular surveys of Irish hare abundance are necessary to establish the extent and pattern of annual fluctuation. Annual deployment of standardised survey methods will enable continued evaluation of relative temporal change in hare abundance.

   b. If accurate estimates of absolute abundance are required, a retrospective re-analysis of hare survey data using custom Distance analysis techniques will be needed. Improvements in Distance analysis methods made by Quercus in collaboration with the Research Unit for Wildlife Population Assessment (RUWPA) in the University of St. Andrews, may enable past, current and future estimates to be refined increasing their accuracy and precision. This may be incorporated into an assessment Irish hare Species Action Plan targets during 2010.

   c. Research on the population biology of Irish hares remains necessary. There is insufficient information on the most basic aspects of demography such as survival and productivity. Particular attention should be given to the influence of pastoral farmland management (e.g. silage harvest) on population recruitment.

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Introduction

The Irish hare (*Lepus timidus hibernicus* Bell, 1837) is the only native lagomorph in Ireland (Fairley, 2001; Hamill, 2001) and is currently classified as an endemic sub-species of the mountain hare (*L. timidus* Linnaeus, 1758). Nevertheless, it differs phenotypically, behaviourally, ecologically and genetically from other mountain hares and recent research suggests it may warrant full species status (Hughes *et al.* 2006).

In Northern Ireland, the Irish hare is protected under the Wildlife Order (NI) 1985 and annual amendments to the Game Preservation (Special Protection for Irish Hares) Order (Northern Ireland) 2003. It is also listed on Appendix III of the Bern Convention (Anon, 1979) and Annex V(a) of the EC Habitats Directive (92/43/EEC), and is listed as an internationally important species in the Irish Red Data Book (Whilde, 1993). Furthermore, subject to a local Northern Ireland and an All-Ireland Species Action Plan (Anon, 2000; 2005) it is one of the highest priority species for conservation action in Northern Ireland.

Interpretation of short-term population changes can only be made in the context of long-term time-series. Recent estimates of Irish hare population abundance in demonstrate substantial interannual and multiannual variation (O'Mahony & Montgomery, 2001; Dingerkus & Montgomery, 2002; Preston *et al.* 2002; Tosh *et al.* 2004; Tosh *et al.* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a; Reid *et al.* 2007b).

For species of conservation concern, the importance of contemporary monitoring data and its direct application to management is widely recognised (Choudhury, 1999, 2002; Battersby & Greenwood; 2004). The Northern Ireland hare survey started in 2002 and has been conducted at annual intervals since 2004 (Preston *et al.* 2002; Tosh *et al.* 2004; Tosh *et al.* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a). In keeping with previous survey objectives the aims of this survey were to:

- Establish the relative abundance of Irish hares in Northern Ireland during 2008.
- Ascertain relative change in hare abundance since 2007.
- Make recommendations for future research.

Methods

Surveys were conducted during early spring (April-May). The eight long-line point transects used in previous Northern Ireland hare surveys (Preston *et al.* 2002; Tosh *et al.* 2004; Tosh *et al.* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a) were resurveyed during 2008. These routes, following minor roads, were approximately 100km in length (834km in total) and were originally selected to bisect a representative sample of landscape types characterised by the land classification system (Murray, McCann & Cooper 1992) throughout all six counties in Northern Ireland (Fig. 1). Survey points were spaced approximately 200m apart on each transect and were surveyed using a 2×10^6 candle-power spotlight from a platform on a high clearance vehicle elevating the observer's head height >2 m above ground level, i.e. above most hedgerows.
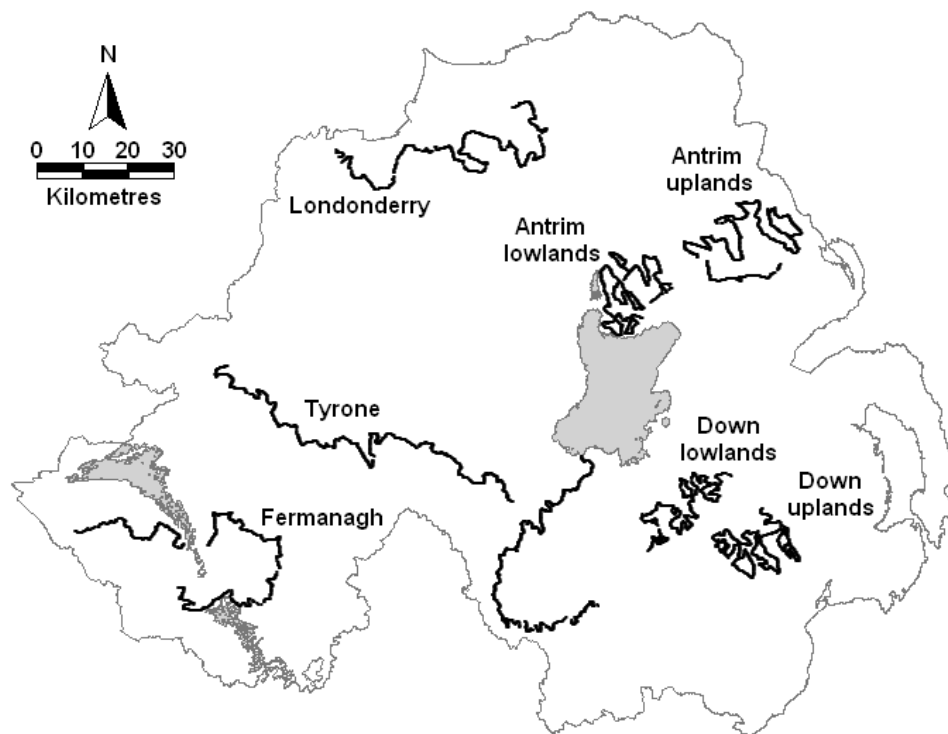

Fig. 1   *Location of long-line point transects identical to those used in previous Northern Ireland hare surveys (Preston et al. 2002; Tosh et al. 2004; Tosh et al. 2005; Hall-Aspland et al. 2006; Reid et al. 2007a).*

The observer systematically swept the spotlight 180 degrees on both sides of the road twice, working from the area closest to the vehicle towards the horizon. Survey effort for each survey point was taken as a measure of the number of degrees within the observer's circle of vision that were visible and not obscured. For each detection of hares, the survey point location (measured to the nearest 10m using a Trimble Global Positioning System), the cluster size (i.e. number of hares), the radial distance of the cluster from the survey point (measured using a laser range finder; Leica LRF 900 scan) and the bearing of the cluster from the direction of travel (measured using compass binoculars; Tasco, Offshore 54, 7x50mm) were recorded. This was repeated for each survey point along the length of each line transect. Surveys were not conducted until one hour after sunset.

Hare density and abundance was estimated using Distance v5 software (Thomas *et al.* 2005). The sample point was taken as the unit for variance estimation with right truncation applied to the upper 10% of sightings. Estimates were stratified by county with three commonly used models constructed for each (Buckland *et al.* 2004), including uniform cosine, half-normal cosine and hazard-rate simple polynomial. The parsimony of each model was evaluated using Akaike's Information Criterion (AIC) with the best model selected on the basis of the lowest AIC value. For direct comparability of results the analytical procedure applied was identical to that of the standard Northern Ireland hare survey method used by Tosh *et al.* (2005), Hall-Aspland *et al.* (2006), and Reid *et al.* (2007a). Consequently, hare density estimates presented here are relative to those of previous surveys.

Results

A total of 187 Irish hares were detected on 8 long-line transects during 2008 (Table 1). No brown hares (*Lepus europaeus*) were detected during this survey. Using the standard Northern Ireland hare survey methodology and not withstanding sources of potential negative bias, the estimated mean density of Irish hares in Northern Ireland during early 2008 was calculated to be 2.86 hares.km^{-2} (95%CI 2.16-3.79) giving a total estimated abundance of 40,500 hares (95%CI 30,613-53,700; Table 2). The mean calculated density was significantly higher than 2002 and significantly lower than 2004 (Fig. 2; Preston *et al.* 2002; Tosh *et al.* 2004). The 95% confidence intervals for the estimates during 2005, 2006 and 2007 overlapped substantially with 2008, but the mean estimate was lower than 2005 and 2007 but higher than 2006 (Fig. 2; Tosh *et al.* 2004; Tosh *et al.* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a).

Table 1 *Total numbers of Irish hare observed in each county on Northern Ireland hare surveys from 2002 to 2008 (Preston et al. 2002; Tosh et al. 2004; Tosh et al. 2005; Hall-Aspland et al. 2006; Reid et al. 2007a; this study).*

County	Year					
	2002	**2004**	**2005**	**2006**	**2007**	**2008**
Antrim	134	120	126	79	137	77
Armagh	17	59	41	17	19	28
Down	63	67	29	29	32	41
Fermanagh	14	60	80	46	44	22
Londonderry	7	34	9	3	4	3
Tyrone	4	33	29	14	11	16
Total	**239**	**373**	**314**	**188**	**247**	**187**

Table 2 *Estimates of Irish hare density and abundance during 2008 using a standardised long-line point transect field methodology and conventional Distance analysis.*

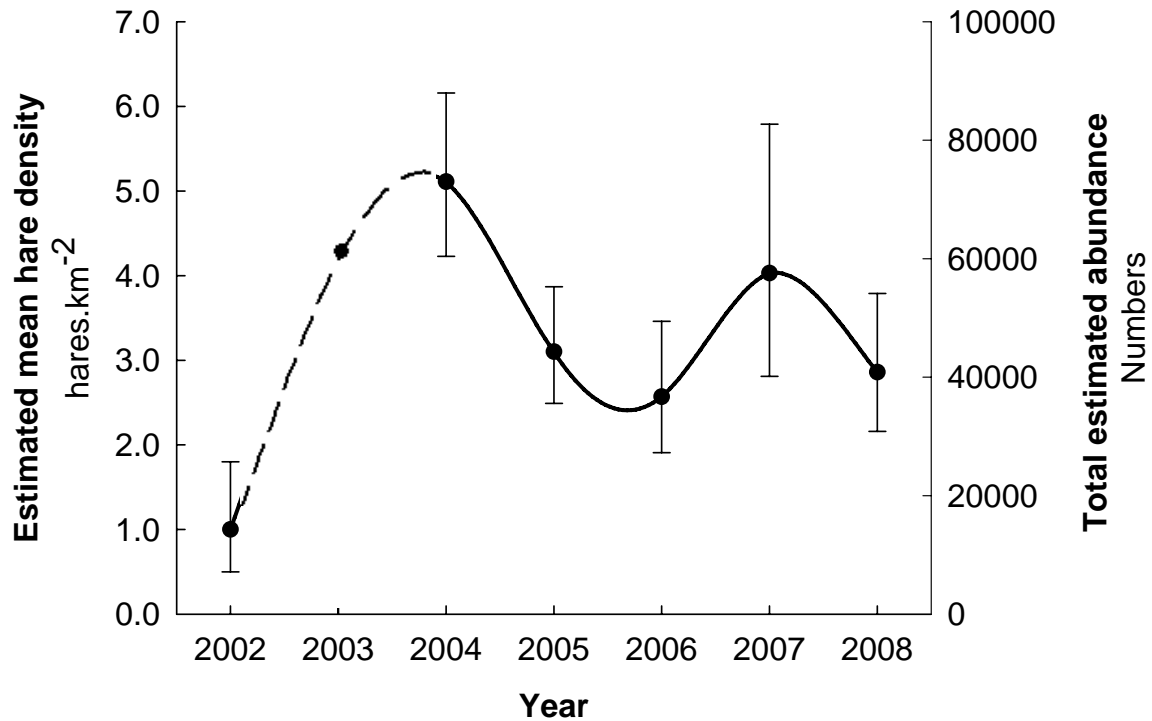| County	Estimated density hares/km^2 (95% CI)	Estimated abundance Numbers (95% CI)
Antrim	4.17 (2.59 - 6.69)	13,100 (8,100 - 21,000)
Armagh	6.05 (3.34 -10.96)	8,000 (4,400 - 14,500)
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Tyrone	0.99 (0.46 - 2.14)	3,200 (1,500 - 7,000)
Global	**2.86 (2.16 - 3.79)**	**40,500 (30,600 – 53,700)**

Fig. 2   *Trends in Irish hare density and abundance estimates ± 95% confidence limits during Northern Ireland Irish hare surveys from 2002 to 2008 (Preston et al. 2002; Tosh et al. 2004; Tosh et al. 2005; Hall-Aspland et al. 2006; Reid et al. 2007a; this study). The line through 2003 has been interpolated.*

Discussion

Night-driven, spotlight surveys have become a favoured method of estimating relative abundance of nocturnal mammals due to their efficiency, repeatability, and lack of interference with the subject (Langbein *et al.*, 1999). It was a stipulation of this contract that the survey protocol and analytical methods should be identical to those of previous surveys (Tosh *et al.,* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a).

Whilst the mean density of Irish hares in Northern Ireland during 2008 was lower relative to that of 2007, there was no statistical difference between the estimates. Hare populations are characterised by substantial interannual and multiannual fluctuations (Elton & Nicholson, 1942; Keith, 1963; Krebs *et al.* 1986; Keith, 1990; Ranta *et al.* 1997; Krebs *et al.* 2001; Reynolds *et al.* 2006; Reid *et al.* 2007b). Consequently, interpretation of trends within short-term time-series should be avoided (Tosh *et al.,* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a). Furthermore, a paucity of data on basic Irish hare ecology, particularly with respect to grassland management makes any changes in mean relative abundance difficult to interpret.

Previous research demonstrated that surveys of hares conducted from roads do not conform to the assumptions of distance-sampling with biased estimates the likely outcome (Reid *et al.* 2007b; Reid *et al.* 2007c). Regardless of potential sources of negative bias, standardised methods enable relative comparison of density estimates between years. Collaborative research undertaken by Quercus with RUWPA at the University of St. Andrews, has yielded novel and innovative methods to deal with problems such as measurement error, uneven sampling and the non-uniform distribution of animal detections (Reid *et al.* 2007b; Reid *et al.* 2007c). We advocate repeat surveys during 2009 and 2010 using standard methods with additional deployment of survey effort during 2010 to enable retrospective re-analysis of hare survey data for the previous decade using new custom Distance analysis techniques, as applied to the Northern Ireland hare survey 2007 (Reid *et al.* 2007c). This may lead to substantial improvements in the accuracy and precision of annual estimates of hare density from 2002 to 2010 enabling the targets of the Irish hare Species Action Plan to be evaluated effectively.

Recommendations

1. Regular surveys of Irish hare abundance are necessary to establish the extent and pattern of annual fluctuation. Annual deployment of standardised survey methods will enable continued evaluation of relative temporal change in hare abundance.

2. If accurate estimates of absolute abundance are required, a retrospective re-analysis of hare survey data using custom Distance analysis techniques will be needed. Improvements in Distance analysis methods made by Quercus in collaboration with the Research Unit for Wildlife Population Assessment (RUWPA) in the University of St. Andrews, may enable past, current and future estimates to be refined increasing their accuracy and precision. This may be incorporated into an assessment Irish hare Species Action Plan targets during 2010.

3. Research on the population biology of Irish hares remains necessary. There is insufficient information on the most basic aspects of demography such as survival and productivity, their relationship with intrinsic and extrinsic factors and the spatial scale at which these factors affect population change. Particular attention should be given to the influence of pastoral farmland management (e.g. silage harvest) on population recruitment.

Acknowledgements

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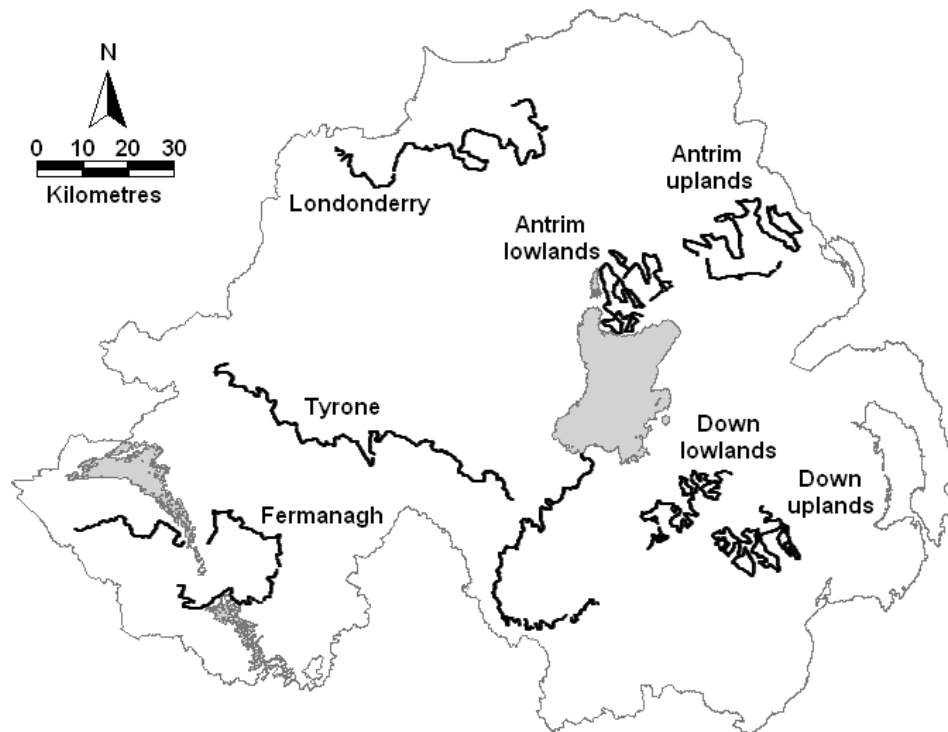

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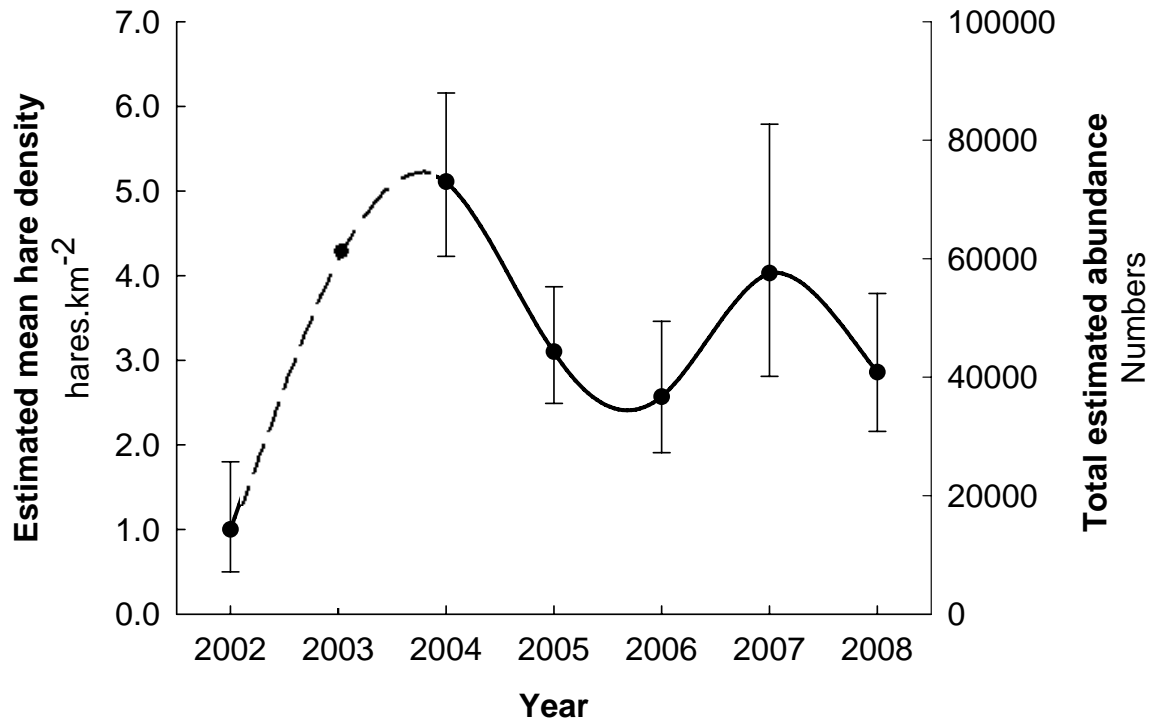| County	Estimated density hares/km^2 (95% CI)	Estimated abundance Numbers (95% CI)
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Discussion

Night-driven, spotlight surveys have become a favoured method of estimating relative abundance of nocturnal mammals due to their efficiency, repeatability, and lack of interference with the subject (Langbein *et al.*, 1999). It was a stipulation of this contract that the survey protocol and analytical methods should be identical to those of previous surveys (Tosh *et al.,* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a).

Whilst the mean density of Irish hares in Northern Ireland during 2008 was lower relative to that of 2007, there was no statistical difference between the estimates. Hare populations are characterised by substantial interannual and multiannual fluctuations (Elton & Nicholson, 1942; Keith, 1963; Krebs *et al.* 1986; Keith, 1990; Ranta *et al.* 1997; Krebs *et al.* 2001; Reynolds *et al.* 2006; Reid *et al.* 2007b). Consequently, interpretation of trends within short-term time-series should be avoided (Tosh *et al.,* 2005; Hall-Aspland *et al.* 2006; Reid *et al.* 2007a). Furthermore, a paucity of data on basic Irish hare ecology, particularly with respect to grassland management makes any changes in mean relative abundance difficult to interpret.

Previous research demonstrated that surveys of hares conducted from roads do not conform to the assumptions of distance-sampling with biased estimates the likely outcome (Reid *et al.* 2007b; Reid *et al.* 2007c). Regardless of potential sources of negative bias, standardised methods enable relative comparison of density estimates between years. Collaborative research undertaken by Quercus with RUWPA at the University of St. Andrews, has yielded novel and innovative methods to deal with problems such as measurement error, uneven sampling and the non-uniform distribution of animal detections (Reid *et al.* 2007b; Reid *et al.* 2007c). We advocate repeat surveys during 2009 and 2010 using standard methods with additional deployment of survey effort during 2010 to enable retrospective re-analysis of hare survey data for the previous decade using new custom Distance analysis techniques, as applied to the Northern Ireland hare survey 2007 (Reid *et al.* 2007c). This may lead to substantial improvements in the accuracy and precision of annual estimates of hare density from 2002 to 2010 enabling the targets of the Irish hare Species Action Plan to be evaluated effectively.

Recommendations

1. Regular surveys of Irish hare abundance are necessary to establish the extent and pattern of annual fluctuation. Annual deployment of standardised survey methods will enable continued evaluation of relative temporal change in hare abundance.

2. If accurate estimates of absolute abundance are required, a retrospective re-analysis of hare survey data using custom Distance analysis techniques will be needed. Improvements in Distance analysis methods made by Quercus in collaboration with the Research Unit for Wildlife Population Assessment (RUWPA) in the University of St. Andrews, may enable past, current and future estimates to be refined increasing their accuracy and precision. This may be incorporated into an assessment Irish hare Species Action Plan targets during 2010.

3. Research on the population biology of Irish hares remains necessary. There is insufficient information on the most basic aspects of demography such as survival and productivity, their relationship with intrinsic and extrinsic factors and the spatial scale at which these factors affect population change. Particular attention should be given to the influence of pastoral farmland management (e.g. silage harvest) on population recruitment.

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