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# Northern Ireland Irish Hare Survey 2007

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## Executive Summary

1. The Northern Ireland hare survey was undertaken during late-winter 2007 and compared to similar surveys from 2002 to 2006. Standardised field survey methods and analytical techniques were employed to enable direct comparisons between years enabling relative change in hare density to be evaluated.

2. Using conventional analysis the mean estimated pre-breeding Irish hare density in Northern Ireland during 2007 was 4.03 hares.km$^{-2}$ (95% CI 2.81-5.79), giving a total estimated abundance of 57,100 hares (95% CI 39,800-82,000).

3. Relative estimated hare abundance during 2007 was higher than during 2006 but the 95% confidence intervals of both estimates overlapped substantially indicating that any change was not statistically significant. Therefore, no major change in the hare population has been observed during this period. The population remains lower than in 2004 but higher than in 2002.

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 methodologies, in keeping with previous Northern Ireland hare surveys, should enable relative change in hare abundance to be evaluated.
   b. 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 the precision and accuracy of absolute hare density estimation.
   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, 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 on population recruitment.

## Contents

## 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.

Recent estimates of hare population abundance in Northern Ireland demonstrate substantial relative interannual 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). General population declines can be ongoing, despite short term increases. Consequently, interpretation of short-term changes can only be made in the context of long-term time-series.

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). In keeping with previous survey objectives the aims of this survey were to:

- Establish the relative abundance of Irish hares in Northern Ireland during 2007.
- Ascertain relative change in hare abundance since 2006.
- Make recommendations for future research.

## Methods

Surveys were conducted during mid-late winter (January-March) when ground vegetation was minimal, maximising the detectability of animals. 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) were resurveyed during 2007. 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 x $10^6$ 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.

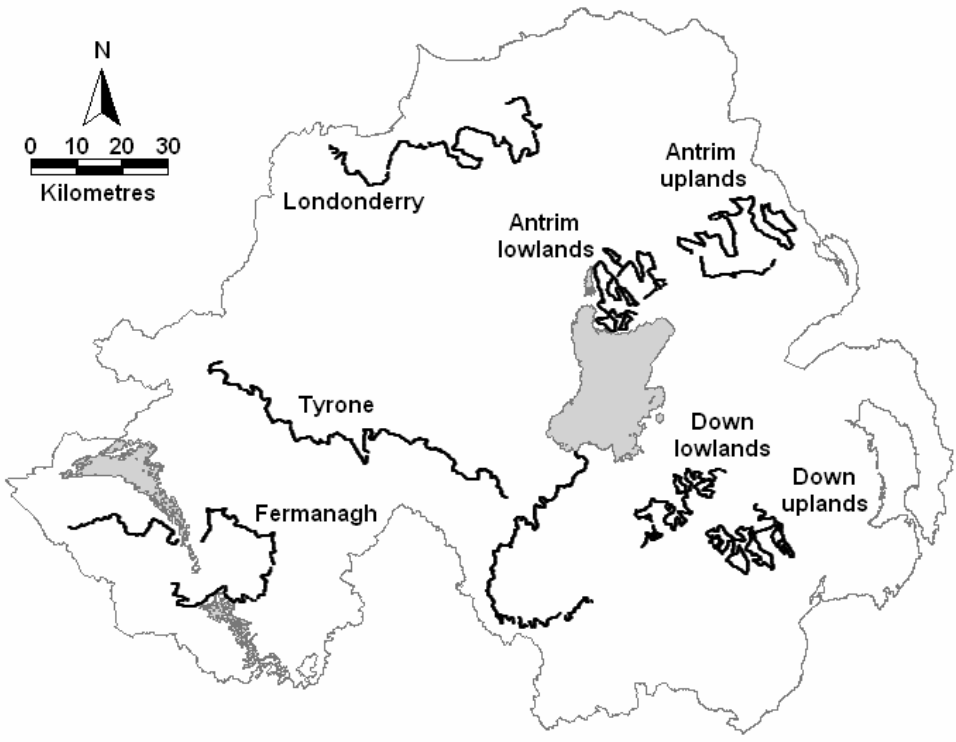


**Fig. 1** *Location of long-line point transects identical to those used in previous Northern Ireland hare surveys (Preston et al. 2002; Tosh et al. 2004; Tosh et al. 2005; Hall-Aspland et al. 2006).*

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) and Hall-Aspland *et al.* (2006). Consequently, hare density estimates presented here are relative to those of previous surveys.

## Results

A total of 247 Irish hares were detected on 8 long-line transects during 2007 (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 pre-breeding density of Irish hares in Northern Ireland during 2007 was calculated to be 4.03 hares.km$^{-2}$ (95% CI 2.81-5.79) giving a total estimated abundance of 57,100 hares (95% CI 39,800-82,000; Table 2). The mean calculated density was significantly higher than that for 2002 (Fig. 2; Preston *et al.* 2002). The 95% confidence intervals for the estimates during 2004, 2005 and 2006 overlapped substantially with those for 2007, but the mean estimate was lower than 2004 and higher than both 2005 and 2006 (Fig. 2; Tosh *et al.* 2004; Tosh *et al.* 2005; Hall-Aspland *et al.* 2006).

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

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

**Table 2** *Estimates of Irish hare density and abundance during 2007 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 | 7.25 (4.87 -10.80) | 22,700 (15,300 - 33,900) |
| Armagh | 3.80 (1.95 - 7.42) | 5,000 (2,600 - 10,000) |
| Down | 1.69 (0.72 - 4.00) | 4,000 (1,800 - 10,000) |
| Fermanagh | 4.92 (3.03 - 7.97) | 9,100 (5,700 - 14,700) |
| Londonderry | 0.59 (0.11 - 3.01) | 1,200 (200 - 6,300) |
| Tyrone | 4.54 (1.50 -13.77) | 14,800 (4,900 - 44,900) |
| **Global** | **4.03 (2.81 - 5.79)** | **57,100 (39,800 - 82,000)** |

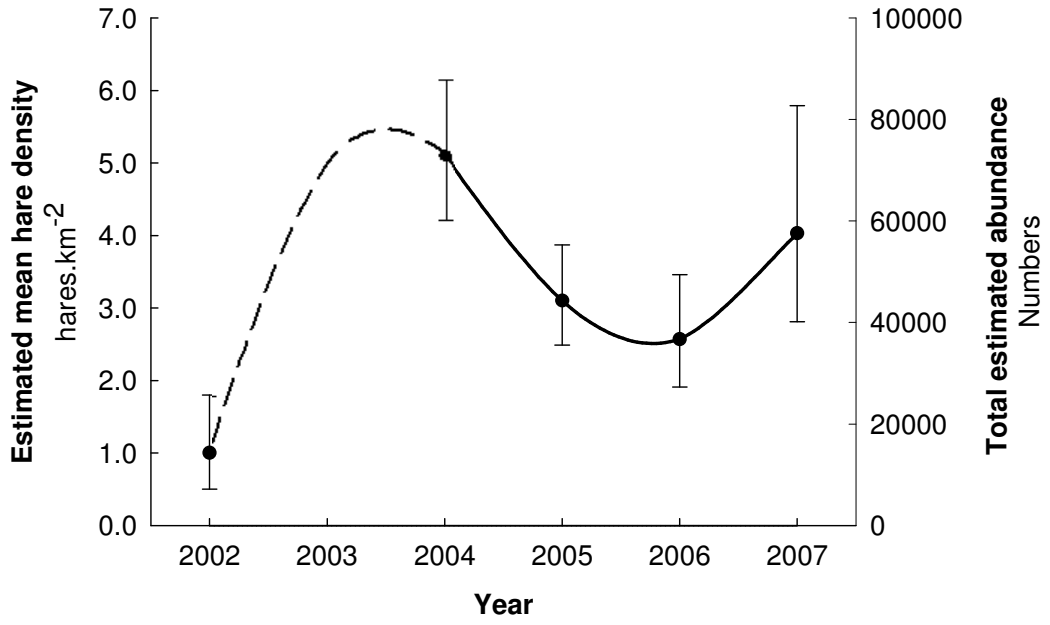


**Fig. 2** *Trends in Irish hare density and abundance estimates ± 95% confidence limits during Northern Ireland hare surveys from 2002 to 2007 (Preston et al. 2002; Tosh et al. 2004; Tosh et al. 2005; Hall-Aspland et al. 2006). The line through 2003 was interpolated using a cubic regression.*

## 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).

Whilst the mean density of Irish hares in Northern Ireland during 2007 was greater relative to that of 2006, 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; Kauhala, 2005; Reynolds *et al*. 2006). Consequently, interpretation of trends within short term time series should be avoided (Tosh *et al.,* 2005; Hall-Aspland *et al.* 2006). Furthermore, a paucity of data on basic Irish hare ecology, particularly with respect to grassland management makes any changes in 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 (Tosh *et al.*, 2004; Tosh *et al.,* 2005; Hall-Aspland *et al.* 2006). Regardless of potential sources of negative bias, standardised methods between years enables relative comparison of annual density estimates. 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. The application of such models to past, current and future data may lead to substantial improvements in the accuracy and precision of absolute hare density estimation.

The European brown hare (*Lepus europaeus*), whilst well established in Northern Ireland (Reid & Montgomery, 2007), has a restricted geographically range not sampled during these surveys. Consequently, no brown hares were detected but they remain a potentially significant threat to the ecological security and genetic integrity of the Irish hare.

## Recommendations

To assess annual relative change in hare density deployment of standardised survey methods, in keeping with previous Northern Ireland hare surveys, is essential. Nonetheless, if the aim of future monitoring is also to produce accurate estimates of absolute hare density, incorporation of statistical innovations made by Quercus in collaboration with RUWPA at the University of St. Andrews, will be necessary.

## Acknowledgements

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