

Environment & Heritage Series

Northern Ireland Irish Hare Survey 2006

Quercus Project QU06-03



Prepared for
Environment & Heritage Service

by

Sophie Hall-Aspland, Oisín Sweeney, David Tosh, Jane Preston,
Ian Montgomery & Robbie McDonald

Quercus project QU06-03
Quercus is a partnership between
Environment & Heritage Service, Northern Ireland and
Queen's University, Belfast
www.quercus.ac.uk

Executive Summary

1. A survey of Irish hares in Northern Ireland was undertaken in spring 2006 and compared to similar surveys in spring 2004 and 2005. The survey was based on observations of hares made at night using a spotlight at points along eight transects on roads. Data were analysed using Distance Sampling.
2. The density of Irish hares was estimated to be 2.57 hares per km² in spring 2006 (and with 95% confidence was between the limits 1.91–3.46). Using this density estimate multiplied by land area the Irish hare population in Northern Ireland was estimated to be 36,200 in 2006 (95% CL 26,900–48,800).
3. The confidence intervals of the population estimates in 2006 and 2005 (43,700 95% CL 35,000–54,400) overlap substantially. Therefore, we suggest there has been no major change in the hare population over this period. The population remains lower than in 2004 and higher than in 2002.
4. We make the four same recommendations for action as those made in our 2004 and 2005 reports.
 - a. Continue with regular surveys of Irish hare numbers. Until the extent and pattern of fluctuations is well established, these should continue to be conducted annually.
 - b. Improvement of the application of Distance Sampling techniques to Irish hare surveys is ongoing and may require further refinement of field sampling and statistical analysis.
 - c. Conduct research on the population biology of Irish hares. 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.
 - d. Investigate the impact of agricultural practices on hare survival and recruitment.

Contents

Executive Summary	2
Introduction	4
Methods	6
Results	8
Discussion	11
Acknowledgements	12
References	12

Introduction

The Irish hare *Lepus timidus hibernicus* is the only lagomorph that is native to Ireland and is commonly recognised as a distinctive subspecies of the mountain hare *Lepus timidus* (Fairley, 2001; Hamill, Doyle & Duke 2006). It is a priority species for conservation action in Northern Ireland.

Research by Queens University Belfast during the 1990s indicated that the Irish hare population in Northern Ireland was between 8,250–21,000 hares and that there was evidence of a decline from historical levels (Dinkerkus, 1997; Dinkerkus & Montgomery, 2002). A Species Action Plan for Irish hares was produced by the Environment and Heritage Service (EHS) containing a series of measures and targets aimed at maintaining and enhancing the status of the Irish hare in Northern Ireland (EHS, 2000). A series of hare surveys have since been commissioned by EHS with the aim of evaluating the Plan's success.

A survey was conducted in 2002 using line transect spotlight surveys, which were conducted while driving along roads at night (Preston *et al.* 2002). Distance Sampling techniques were applied to determine hare densities. The population was estimated to have been 7,000–25,200 hares, indicating that hare numbers had not changed significantly since the previous estimate during the 1990s.

Quercus was commissioned by EHS to conduct further surveys in spring 2004. The field protocol was modified between 2002 and 2004 for health and safety reasons; observations were made with a spotlight at a series of point transects distributed along the previously adopted line transects. Estimates of hare densities increased markedly between surveys, suggesting that the population had undergone a marked increase between 2002 and 2004 (Tosh *et al.* 2004).

In 2005, a similar protocol was adopted as in 2004. Explicit consideration of survey effort (point visibility) and the more precise recording of distance together with improved analytical methods led to revised estimates for 2004 being provided in the 2005 report. The marked increase seen between 2002 and 2004 retained support, and a decline in population estimates was observed between the 2004 and 2005 surveys (Tosh *et al.* 2005).

EHS commissioned a further survey from Quercus in 2006. The field protocol and analytical methods adopted in 2005 were maintained in the 2006 survey to ensure comparability with previous reports.

The objectives of the 2006 survey were to:

- Establish the abundance of Irish hares in Northern Ireland in 2006.
- Ascertain change in abundance since 2005.
- Make recommendations for future work.

Methods

Fieldwork was conducted from February to May 2006 along the eight transects used in the 2002, 2004 and 2005 surveys. These routes were approximately 100km in length and were located such that they encompassed a typical sample of landscape types as characterised by the land classification system (Murray, McCann & Cooper 1992). The transects were located in all six counties of Northern Ireland (Figure 1), with 2 transects conducted each in counties Antrim and Down.

A Nissan pick-up truck was driven along a transect, stopping at approximately 200m intervals. Hares were searched for by a single observer standing on the rear of the truck using a 2 million candlepower handheld spotlight. Two observers (Hall-Aspland and Sweeney) conducted series of 30 survey points in random order. The observer systematically swept the spotlight 180 degrees on one side working from the area closest to the vehicle towards the horizon. Two sweeps were carried out on each side of the vehicle. The sector of observations over which the view was not obscured, e.g. by tall hedges, was noted in degrees and used as a measure of survey effort at each point. This was repeated along the length of a transect until it was completed. The observer (Tosh) who conducted the surveys during 2004 and 2005 also conducted a series of 30 points for one night on every transect to allow for comparison of detection ability among observers. The presence or absence of hares was noted at each point. Where hares were detected, the number of animals seen, the distance from the observer in metres (measured using a laser range finder, Leica LRF 900 scan), bearing (measured using compass binoculars, Tasco, Offshore 54, 7x50mm) and position in the field was noted. At each point, the distance travelled along the transect and position to the nearest 10m were recorded using a Trimble Global Positioning System (GPS). Transects were surveyed from sunset for 5–7 hours a night. Between 20–25km of a transect was surveyed each night and each transect required 4–5 nights survey effort.

Between observer variability in recorded distance to hare clusters was tested using a t-test between observers Hall-Aspland and Sweeney (who presented homogeneous variances in the Levene test) and a non parametric Kruskal-Wallis test between observers Hall-Aspland, Sweeney and Tosh, where variances were unequal. The repeatability of observations among observers within transects was estimated by calculation of the intra-class correlation co-efficient of mean distances to hare clusters recorded by each observer on each transect. Repeatability (R) indicates the relative proportion of the variation in the data occurring among

observers. Perfectly repeatable measurements result in a value of $R=1.0$. Consistency in the placement of observations among observers was described by fitting density ellipses to the co-ordinates.

Hare densities were estimated using DISTANCE 5 version Beta 5 (Thomas *et al.* 2005), which is an upgraded version of Beta 4, used for the 2005 data analysis. The analytical procedure was identical to that applied to the 2005 data and was verified by reproducing the previous year's results.

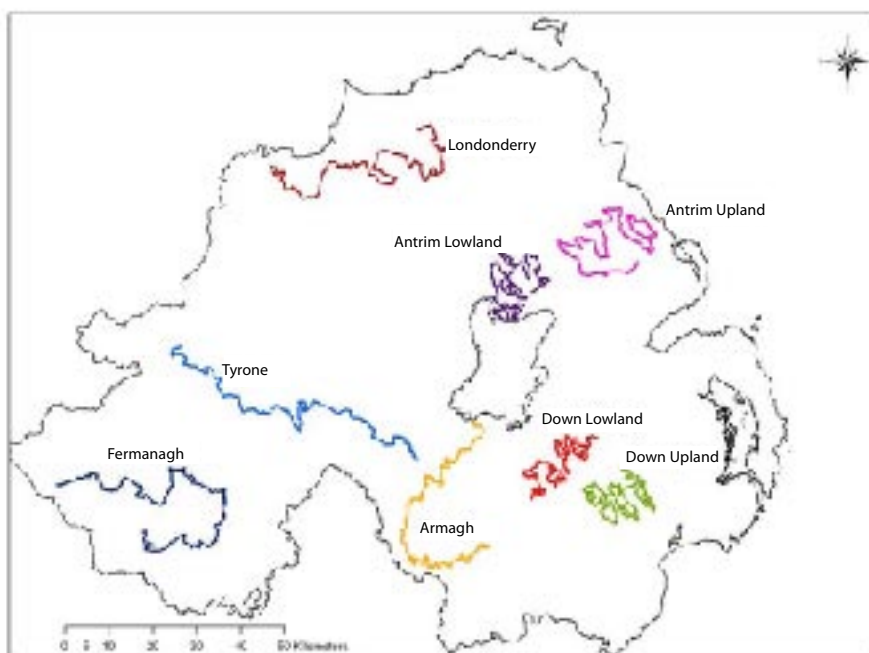


Figure 1. Location of hare survey transects

Results

A total of 188 Irish hares were detected on the 8 transects surveyed in 2006 (Table 1). Similar numbers of clusters were recorded by two observers Hall-Aspland (n=52) and Sweeney (n=57). Matched transect sections that were conducted by three observers also recorded similar numbers of clusters, Hall-Aspland (n=9), Sweeney (n=10) and Tosh (n=9). There were no significant differences in the hare distances recorded between the two principal observers, (t-test, $t=0.40$, $df=107$, $p=0.69$) or the three observers (Kruskal-Wallis test, $\chi^2=3.872$, $df=2$, $p=1.44$). Repeatability of distance measurements among observers was high ($r = 0.87$; Figure 2). There was consistency among observers in the position of detected hares (Figure 3).

Table 1. Numbers of Irish hares seen in each county.

County	Number of hares seen			
	2002	2004	2005	2006
Antrim	134	120	126	79
Armagh	17	59	41	17
Down	63	67	29	29
Fermanagh	14	60	80	46
Londonderry	7	34	9	3
Tyrone	4	33	29	14
Total	239	373	314	188

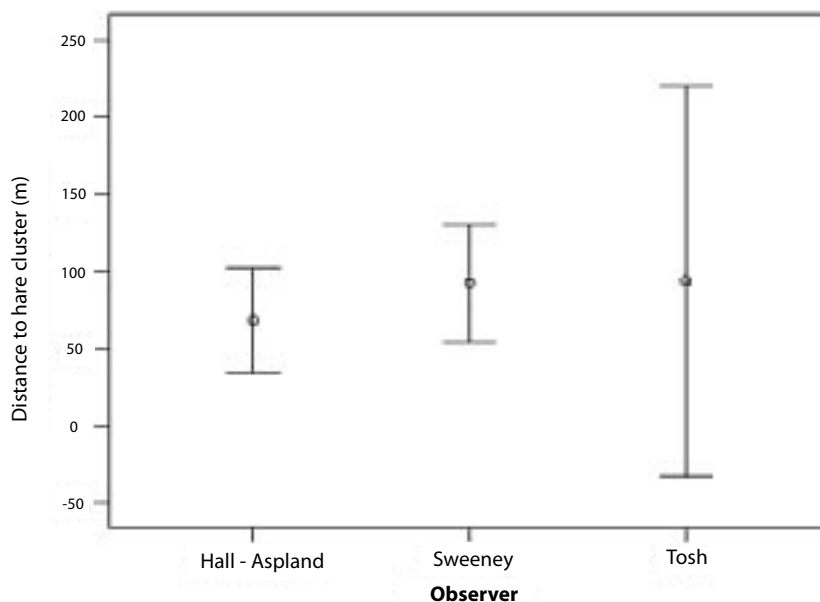


Figure 2. Mean and 95% confidence intervals of distance to hare clusters for three observers within matched transects sections for repeatability analysis.

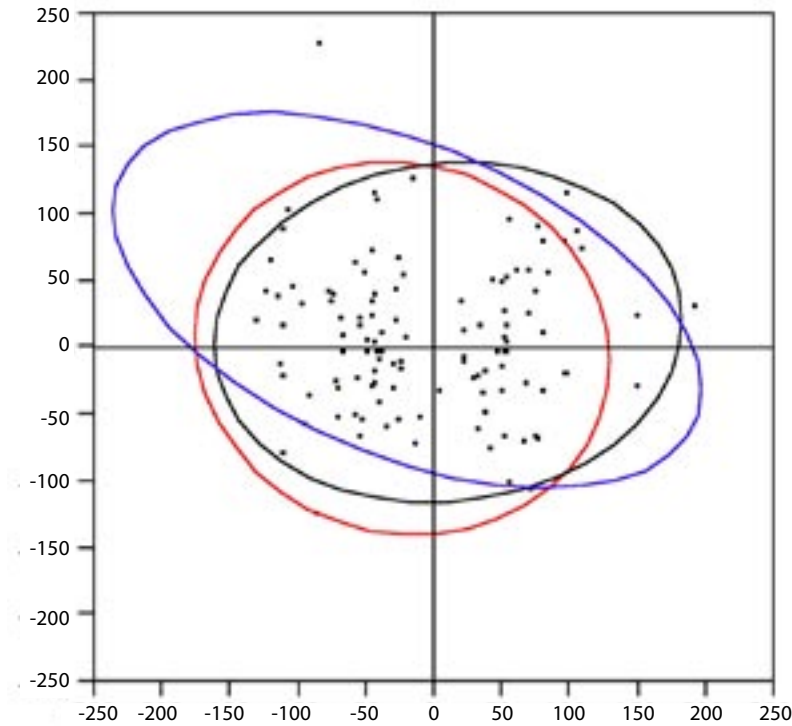
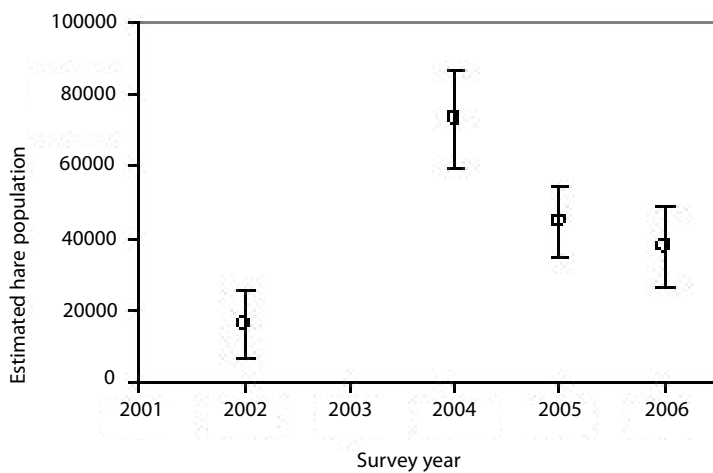


Figure 3. Position of detected hares with respect to the point, considered to be centered at (0,0). Density ellipses for each observer, Hall-Aspland —, Sweeney — and Tosh — represent 95% of observations.

Notwithstanding remaining sources of analytical bias, in 2006 the overall density of Irish hares in Northern Ireland was estimated to be 2.57 hares per km² (95% confidence interval CI 1.91–3.46). The population of Irish hares in Northern Ireland in spring 2006 was estimated to be 36,200 (95% CI 26,900–48,800) (Table 2). The confidence estimates overlap between 2005 and 2006, however the population remains lower than in 2004 and higher than in 2002 (Figure 4).



95% confidence interval). There was no survey conducted in 2003.

Table 2. Estimates of Irish hare density for each county.

County	Year	Density (95%CI)		Abundance (95% CI)	
Antrim	2006	3.52	(2.32-5.33)	10700	(7100-16300)
	2005	3.44	(2.49-4.76)	10500	(7600-14500)
	2004	5.42	(3.77-7.81)	16600	(11600-24000)
Armagh	2006	3.28	(1.60-6.73)	4400	(2100-8900)
	2005	2.62	(1.26-5.47)	3500	(1700-7300)
	2004	8.41	(5.74-12.33)	11200	(7600-16400)
Down	2006	0.89	(0.48-1.66)	2200	(1200-4100)
	2005	1.50	(0.67-3.34)	3700	(1700-8300)
	2004	3.77	(2.67-5.32)	9300	(6600-13200)
Fermanagh	2006	5.67	(2.83-11.34)	10500	(5200-21000)
	2005	5.88	(4.20-8.21)	10900	(7800-15200)
	2004	8.43	(5.83-12.19)	15600	(10800-22600)
Londonderry	2006	0.20	(0.07-0.56)	400	(200-1200)
	2005	1.05	(0.24-4.52)	2200	(500-9600)
	2004	3.28	(1.32-8.12)	6900	(2800-17200)
Tyrone	2006	2.44	(1.25-4.79)	8000	(4100-15600)
	2005	3.94	(2.42-6.42)	12900	(7900-21000)
	2004	3.78	(2.25-6.33)	12300	(7300-20700)
Global	2006	2.57	(1.91-3.46)	36200	(26900-48800)
	2005	3.10	(2.49-3.87)	43700	(35000-54400)
	2004	5.11	(4.23-6.16)	72000	(59700-86900)

Discussion

Spotlight surveys along road transects have been favoured as the best means of rapidly and economically surveying hare populations in Northern Ireland and it was a stipulation of this contract that the survey protocol and analytical methods should be identical to those reported in 2005.

This survey indicates that there has been no major change in the Irish hare population in Northern Ireland between 2005 and 2006. We have previously cautioned against interpretation of short time series as trends in populations (Tosh *et al.* 2004, 2005). Given that rapid, marked changes in abundance and multi annual fluctuations appear to characterize hare populations (Elton & Nicholson, 1942, Krebs *et al.* 2001, Reynolds *et al.* 2006) inferring trends remains ill advised with short time series. Furthermore, scant knowledge of local dynamics and of hare ecology means that responses to management are hard to predict. It remains important to improve understanding of the most basic aspects of Irish hare ecology in order to make any substantial assessment of the reasons for population change, or to evaluate management actions or proposals.

Recent research undertaken in partnership with the Centre for Research into Ecological and Environmental Modelling, University of St Andrews has produced prototype methods to deal in part with measurement error, uneven sampling and non-random animal distributions. In the course of this work, it has been suggested that the traditional method of distance sampling may lead to considerable bias due to the non-random allocation of samplers leading to a non-uniform distribution of animals with respect to samplers, i.e. since hares appear to avoid field boundaries, a non uniform distribution of animals with respect to a transect placed along a road may occur (Figure 3). To account for this, a likelihood approach incorporating an availability model along with the usual detectability model was developed (Marques *et al.* in review). It is anticipated that once finalised this method of analysis will be incorporated into future survey analysis techniques and may lead to substantial improvements in the accuracy and precision of analytical methods.

Acknowledgements

This project was funded by the Environment & Heritage Service and Queen's University Belfast through the Quercus partnership. We are grateful to Alex Portig and John Kelly for technical advice and Nic Beddoe, Emmett Clarkin, Hannah O'Kelly, Francis O'Donnell, Rory Finlay and Michael McLoughlin for assistance with fieldwork.

References

- Dinkerku, S.K. (1997). The distribution and ecology of the Irish hare *L.t. hibernicus* in Northern Ireland. Unpublished PhD thesis. Queens University Belfast, UK.
- Dinkerku, S.K. & Montgomery, W.I (2002). A review of the status and decline in abundance of the Irish Hare (*Lepus timidus hibernicus*) in Northern Ireland. Mammal Review, 32, 1-11.
- Elton, C.S. & Nicholson, M. (1942). The ten year cycle in numbers of the lynx in Canada. Journal of Zoology, 11, 215-244.
- Environment & Heritage Service (2000). Biodiversity in Northern Ireland. Northern Ireland Species Action Plan. Irish Hare, Chough and Curlew. The Stationary Office, Belfast.
- Fairley, J. (2001). A Basket of weasels. Privately published, Belfast.
- Hamill, R., Doyle, D., & Duke, E.J. (2006). Spatial patterns of genetic diversity across European subspecies of the mountain hare, *Lepus timidus* L. Heredity, online advance publication, doi:10.1038/sj.hdy.6800880
- Krebs, C.J., Boonstra, R., Boutin, S. & Sinclair, A.R.E. (2001). What drives the 10-year cycle of snowshoe hares? BioScience, 51, 25-35.
- Marques, T.A., Buckland, S.T., Borchers, D.L. & McDonald, R.A. (in review) Point transect sampling along non-random routes. Biometrics.
- Murray, R., McCann, T. & Cooper, A. (1992). A land classification and landscape ecological study of Northern Ireland. University of Ulster, Coleraine.
- Preston, J., Prodöhl, P., Portig, A. & Montgomery, I. (2002). The Northern Ireland Hare *Lepus timidus hibernicus* Survey 2002. Queen's University Belfast.
- Reynolds, J.C., O'Mahoney, D.O. & Aebicher, N.J. (2006). Implications of 'cyclical' population dynamics for the conservation of Irish hares (*Lepus timidus hibernicus*). Journal of Zoology, doi:10.1111/j.1469-7998.2006.00147.x
- Sauer, J.R., Peterjohn, B.G., & Link, W.A. (1994). Observer differences in the North American breeding bird survey. The Auk, 111, 50-62.
- Thomas, L., Laake, J.L., Strindberg, S., Marques, F.F.C., Buckland, S.T., Borchers, D.L., Anderson, D.R., Burnham, K.P., Hedley, S.L., Pollard, J.H., Bishop,

J.R.B. & Marques, T.A. (2005). Distance 5.0 beta 5. Research Unit for Wildlife Population Assessment, University of St Andrews, UK.
<http://www.rupa.st-and.ac.uk/distance/>

Tosh, D., Towers, R., Preston, J., Portig, A., McDonald, R. & Montgomery, I. (2004). Northern Ireland Irish hare survey 2004. Report to the Environment & Heritage Service, Quercus, Belfast.

Tosh, D., Marques, T.A., Brown, S., Preston, S., Reid, N., Montgomery, I., Borchers, D.L., Buckland, S.T. & McDonald, R. (2005). Northern Ireland Irish Hare Survey 2005. Report to the Environment & Heritage Service, Quercus, Belfast.



Our aim is to protect, conserve and promote the natural and built environment for the benefit of present and future generations.

Environment & Heritage Service
Commonwealth House
35 Castle Street
Belfast BT1 1GU
Tel: (028) 9054 6565
Email: info@ehsni.gov.uk
www.ehsni.gov.uk

ISBN No.