Northern Ireland Irish Hare Survey 2004

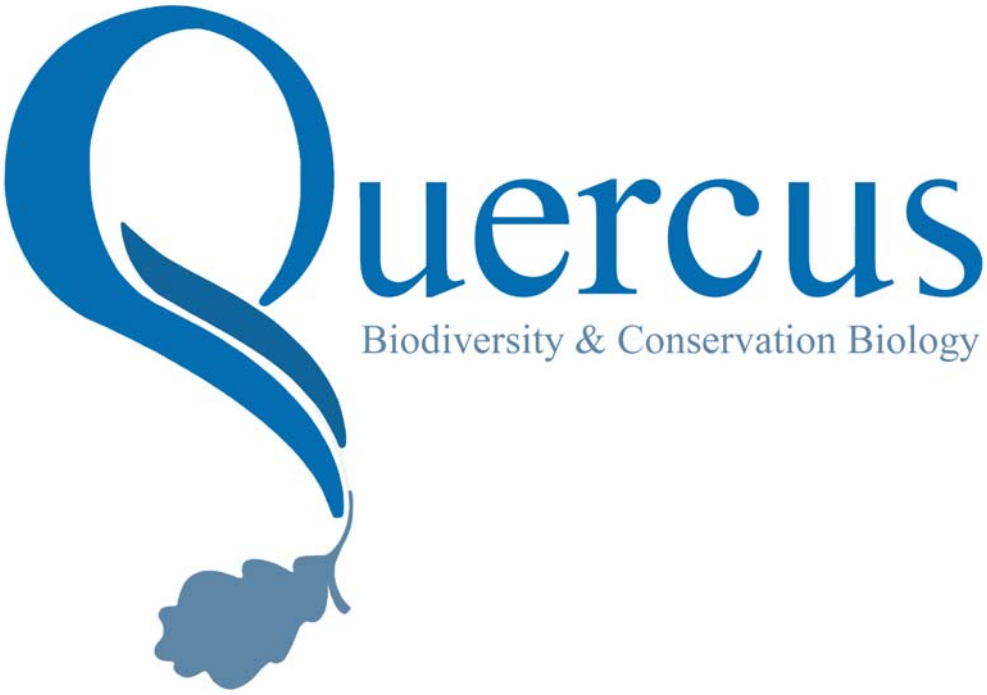
Prepared for

Environment & Heritage Service

by

David Tosh, Ross Towers, Jane Preston, Alex Portig,

Robbie McDonald & Ian Montgomery



Quercus project QU04-01
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Executive summary

1. A survey of Irish hares in Northern Ireland was undertaken in spring 2004 and compared to a similar survey undertaken in spring 2002. The survey was based on observations of hares made at night using a spotlight while driving 8 transects along roads. Hare density was estimated using Distance Sampling and populations were derived by multiplying density by land area.

2. In spring 2004, the density of Irish hares was estimated to be 5.87 hares per km² (and with 95% confidence was between the intervals 4.94–6.99). In 2002, density was estimated to be 1.0 hares per km^2 (95% CI 0.5–1.8). In 2004, the population of Irish hares in Northern Ireland was estimated to be 82,200 (95% CI 69,200–97,900). In 2002, the estimate was 14,000 (95% CI 7,000–25,200).

3. This survey provides evidence of a marked increase in hare numbers between 2002 and 2004, and indicates the potential of the species to increase rapidly from low densities. This is not, however, indicative of a general trend, since large annual fluctuations are characteristic of hare populations.

4. The increase may have stemmed from unusually low hare numbers at the time of the last survey and unusually high recruitment since then. In the absence of detailed knowledge of the factors affecting Irish hare survival, we speculate that this may have been due to a sequence of climatic events, interacting with temporary, large scale changes in patterns of grassland management.

5. We make four recommendations for action:

a. Continue with regular surveys of Irish hare numbers. Until the extent of annual fluctuations is well known, these should be conducted annually.

b. Improve the ability of surveys to detect trends in hare populations over time. This requires a specific study to develop monitoring techniques and could involve a collaborative project with the developers of Distance Sampling.

c. Conduct research into the population biology of Irish hares. There is insufficient information on the most basic aspects of demography, such as survival and fertility, and their relationship with intrinsic and extrinsic factors.

d. Investigate the impact of agricultural practices on hare survival and recruitment. This should focus on grassland management and specifically the effects of grass rolling and silage cutting on leveret survival.

Contents

Introduction

The Irish hare *Lepus timidus hibernicus* is the only lagomorph that is endemic to Ireland and is commonly recognized as a sub-species of the mountain hare *Lepus timidus* (Fairley 2001; Hamill 2001). The mountain hare is found across the Palaearctic, inhabiting upland areas from Alaska to Siberia (Corbet & Harris 1991). While recorded in upland areas in Ireland, the Irish hare also inhabits lowland sites that include farmland, coastal grasslands and lowland bogs (Fairley 2001). In lowland environments in Great Britain and continental Europe, the brown or European hare *Lepus europaeus* is more common.

The colour and size of the Irish hare distinguish it from the rabbit *Oryctolagus cuniculus*; adults are russet brown in colour and can weigh twice as much as a rabbit (2.3–4.3 kg) (Corbet & Harris 1991). Unlike the mountain hare, the Irish hare does not turn white in winter (Hayden & Harrington 2000). Breeding occurs from December to October and 2–3 litters of 2–3 leverets are born a year (Fairley 2001). Mortality of young is typically high; and studies of mountain hares indicate that up to 76% of leverets fail to survive past their first year (Hewson 1965).

Mountain hares are generalist herbivores and heather *Calluna vulgaris* comprises 50% of mountain hare diet in Scotland whilst grasses are present to a lesser extent (Flux 1969). In Northern Ireland, the diet of Irish hares is dominated by a variety of grass species (Dingerkus & Montgomery 2001).

Background to the survey

A survey undertaken during the mid-1990s estimated the population of Irish hares in Northern Ireland to be between 8,250 and 21,000 hares (Dingerkus 1997; Dingerkus & Montgomery 2002). The species was widespread across Northern Ireland but the study suggested that numbers had fallen substantially over time (Dingerkus 1997; Dingerkus & Montgomery 2002). As a consequence, a Species Action Plan was published in 2000 (Environment & Heritage Service 2000). This highlighted potential causes for the apparent decline and created targets for conserving hares.

The main objectives and targets of the Species Action Plan were to:

- maintain the existing range and demonstrate a population increase by 2005
- double the present population by 2010 over as much of the range as possible
- maintain and increase the area and quality of suitable hare habitat

In order to assist with realising these targets, a better understanding of the changing status of the Irish hare was required. In 2002, Queen's University Belfast was commissioned by EHS to conduct a survey of the abundance and distribution of Irish hares in Northern Ireland. This survey estimated the population to be between 7,000 and 25,200 and concluded that there was no evidence of major change in the abundance of Irish hares in Northern Ireland since the 1990s (Preston *et al.* 2002).

The objectives of the current study were to:

- Establish the current abundance and distribution of Irish hares in Northern Ireland
- Ascertain change in distribution and abundance since 2002
- Examine land class, habitat and management patterns that positively and negatively affect abundance
- Make recommendations for future work on Irish hares with respect to population monitoring

Methods

A survey was carried out from March to May 2004 and was undertaken along the eight road transects used in the 2002 survey. These routes were approximately 100 km in length and were located such that they encompassed a typical sample of landscape types as characterized by the land classification system (Murray, McCann & Cooper 1992). The transects were located in all six counties of Northern Ireland (Figure 1).

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 a platform mounted on the rear of the truck using a 2 million candlepower handheld spotlight. 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 done on each side of the vehicle. This was repeated along the length of a transect until it was completed. One observer (DT) conducted all counts during the survey. Where spotlighting was not effective at points where the view was obscured by vegetation, the nearest gap in the roadside vegetation was sought. The presence of absence of hares was noted at each point. Where hares were seen, the number of animals seen, the distance from the observer in metres, bearing and position in field were noted. At each point, the distance travelled (kilometres) and position to the nearest 10 m using a Global Positioning System (GPS) were recorded. Transects were surveyed from sunset for 5–7 hours a night. Between 20–25 km of a transect was surveyed each night and each transect required 4–5 nights survey effort.

A similar survey protocol was adopted in the 2002 survey (Preston *et al*. 2002). For Health and Safety reasons, the 2002 protocol was modified such that the observer did not stand on the back of the vehicle while it was in motion. This also allowed both sides of the road to be surveyed in one drive of the transect, whereas in 2002 each transect was driven twice with surveys over only a 180^{o} arc. Therefore, the 2004 survey was analysed as a series of points, rather than as a line transect.

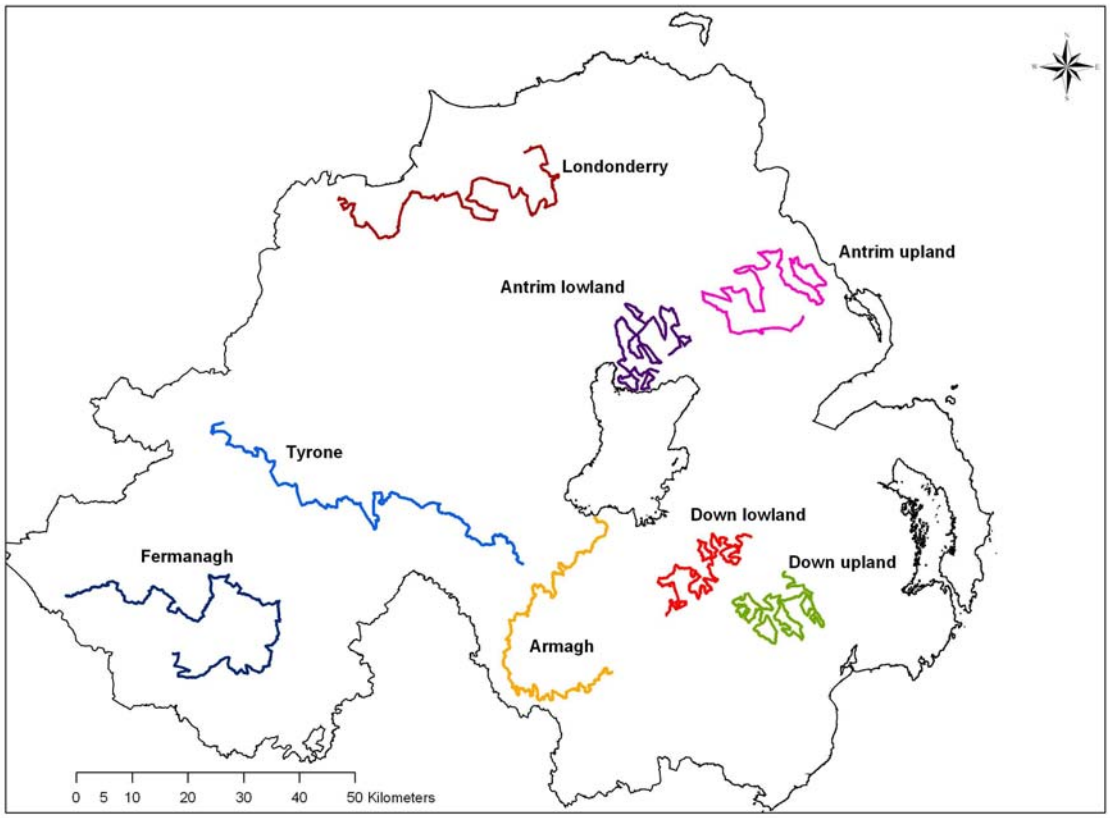

Figure 1. Location of hare survey transects

Density was estimated using Distance Sampling techniques (Buckland *et al*. 2000). Data were entered into the programme DISTANCE 4.1 (similar to and based on same mathematical principles as DISTANCE 3.5 which was used by Preston *et al*. 2002; Thomas *et al*. 2003). Sightings of more than one hare at the same distance were entered as clusters. The distribution of sightings of hares was truncated to the right at 82.5 m, eliminating the most distant sightings that formed the upper 10% of sightings (Buckland *et al*. 2000). Left truncation was applied at 2.5 m. Data were grouped into 10 m intervals and a range of model curves was fitted to the distribution of sightings in accordance with the recommendations of Buckland *et al*. (2001). The best fitting model was selected by the lowest value for the Akaike Information Criterion (AIC). Initial examination of the data identified the uniform cosine model to provide the best fit and density was estimated using this model. The population of Irish hares in Northern Ireland was estimated by multiplying the density estimate for the whole region by its land area and rounding to the nearest

100. The total land area was taken as 14,000 km^2 and excluded the land cover types Inland Water and Sea/Estuary.

A typical range of 10 ha (N. Reid, unpublished data) was imposed on the location of each hare that was seen. The representation of land cover types (Fuller *et al*. 2002) in this circle was calculated in a GIS using a grid of 25 m^2. These values were pooled and compared to the representation of these land cover types for the whole of Northern Ireland using compositional analysis (Compos Analysis Version 4.1; Smith 2003). This technique allows habitats to be ranked in order of their relative use and determines whether animals use the habitats available to them at random or in a selective way. This serves as a very coarse indicator of the habitat preference of hares. Land cover types such as Inland Water and Sea/Estuary that were unsuitable for hares were excluded from the analysis.

Table 1. Availability of land cover types (Fuller *et al*. 2002) suitable for hares in Northern Ireland. Land classes representing less than 0.5% of land cover are excluded.

Land cover type	Description	% cover in Northern Ireland
5.1	Improved grassland	53.4
6.1	Neutral grass	9.7
4.2	Arable horticulture	7.7
8.1	Acid grass	6.0
7.1	Calcareous grass	4.5
17.1	Suburban/rural development	3.9
12.1	Bog	3.0
10.1	Dense dwarf shrub heath	2.7
10.2	Open dwarf shrub heath	2.6
16.1	Inland bare ground	2.6
1.1	Broad leaf/mixed woodland	2.0
2.1	Coniferous woodland	0.9

Results

In 2004, a total of 376 Irish hares were seen on eight transects. In the 2002 survey, 239 hares were seen (Table 2). No brown hares were seen in either survey. In 2004, the density of Irish hares in Northern Ireland was estimated to be 5.87 hares per km² (95 % confidence interval[1] 4.94–6.99). In the 2002 survey, density was estimated to be 1.0 hares per km^2 (95% CI 0.5-1.8). The population of Irish hares in Northern Ireland in spring 2004 was estimated to be 82,200 (95% CI 69,200–97,900). In the 2002 survey, the population was estimated to be 14,000 (95% CI 7,000–25,200).[2]

There was no significant selection of land cover types by hares; land cover types were used in proportion to their availability. Most hares were observed in Improved Grassland which makes up 53% of the suitable land cover in Northern Ireland.

Table 2. Numbers of hares seen on each transect in the 2002 & 2004 surveys

Transect	Number of hares seen	
	2002	2004
Armagh	17	59
Londonderry	7	34
Fermanagh	14	63
Tyrone	4	34
Antrim-Upland	110	66
Antrim-Lowland	24	53
Down-Upland	54	48
Down-Lowland	9	19
Total	**239**	**376**

[1] The 95% confidence interval is a standard measure of statistical error and indicates the range of values within which the true density is 95% certain to lie. Where 95% confidence intervals of two estimates do not overlap, one can be confident of a significant difference between them.

[2] Distance Sampling techniques allow the estimation of density based on the distances at which hares are seen by the observer, rather than simple counts per area surveyed. Thus changes in density mostly reflect changes in the dispersion of hares relative to the observer and so will not necessarily be in proportion to changes in the numbers of hares seen.

Discussion

Night–driven transects were recommended by Preston *et al*. (2002) as the most efficient method of providing large scale survey data for Irish hares in Northern Ireland. Therefore, it was a stipulation of this contract that this survey followed the protocol adopted by Preston *et al*. (2002). With minor alterations this was the case. Comparison of populations between the two surveys was made using estimates of average density over the whole region rather than simple counts. Therefore, despite minor changes in methodology the surveys are comparable. Night-driven spotlight surveys driven along roads do not conform strictly to all of the formal statistical assumptions of Distance Sampling (Buckland *et al*. 2000). Nonetheless, Distance Sampling is recognised as the best compromise between accuracy, precision and effort as a technique to estimate mountain hare density (Newey *et al*. 2003) and spotlight point transect sampling in particular is a favoured method for accurately determining the density of brown hares (Péroux *et al*. 1997; Langbein *et al*. 1999).

It is evident from the marked differences in hare sightings and estimates of density that there has been an increase in hare density, and resultant estimates of the hare population in Northern Ireland between 2002 and 2004. The degree of increase is such that there is no overlap in the confidence intervals between the two surveys and we can be confident that hare numbers have genuinely increased over this period.

This increase is indicative of the potential for Irish hare densities to increase from low points in short spaces of time when conditions are favourable. While the increase can not be related to any deliberate management action between 2002 and 2004, it is at least supportive of the feasibility of the Species Action Plan objectives to "maintain the existing range demonstrate a population increase by 2005" and to "double the population by 2010 over as much of the range as possible" (Environment & Heritage Service 2000). Comparison of two points in time, however, can not be interpreted as a trend or as indicating longer-term and lasting population change. These data do not show whether the population is generally increasing or declining. Such a conclusion would require a longer run of comparable data, and an

understanding of the degree to which fluctuations are typical of local and regional hare numbers.

Information regarding fluctuations of Irish hare populations is limited. Dingerkus & Montgomery (2002) examined game bag records from estates in Counties Down, Tyrone and Fermanagh and concluded that numbers in the past were probably higher (Dingerkus & Montgomery 2002). Records of shooting and netting from Castle Archdale in County Fermanagh are the best available and span 80 years (Figure 2). These historical records indicate that large fluctuations were characteristic of Irish hare numbers. Long-term game bag records from Scotland also indicate that mountain hare numbers are subject to large fluctuations (Hewson 1985). The Game Conservancy Trust's National Game Bag Census indicates that fluctuations in mountain hare numbers are not uncommon (Tapper 1987, 1992). While the degree of change between 2002 and 2004 appears particularly marked, it is not without precedent in historical records of Irish and mountain hare numbers.

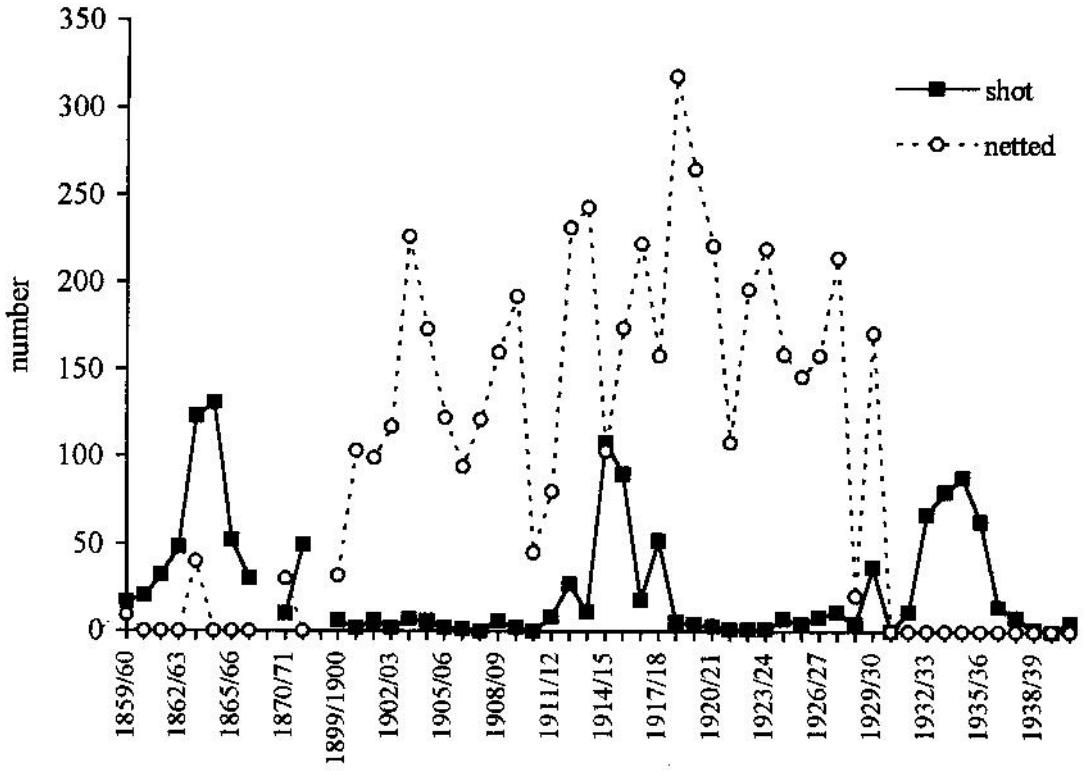

Figure 2. Netting and shooting records from Castle Archdale, Co. Fermanagh (reproduced from Dingerkus 1997).

This survey was not designed to provide evidence for the reasons for changes in hare numbers over time. Therefore, our explanations are speculative and require testing of formal hypotheses. It is unlikely that changes to patterns of adult survival could have resulted in such a pronounced change without concurrent major changes in the productivity and survival of leverets. Clearly, the period between the two surveys must have experienced unusually high levels of recruitment of young hares to the breeding population (Hewson 1985) and such marked changes over short periods are unlikely to have resulted from longer term change in agricultural practice such as recent gradual reductions in fertiliser inputs.

Mechanisms for enhanced recruitment include increased fertility and increased juvenile survival. We have no evidence of increased fertility and this basic aspect of Irish hare biology is very poorly understood. We can, however, speculate on reasons for the increased survival of leverets. Hewson (1965, 1985) has suggested that cold winter weather affects the overwinter survival of mountain hares. Colder winters have also been shown to delay the onset of breeding in other lagomorphs (Cary & Keith 1978). In Northern Ireland, wet weather in spring and summer can lead to large scale changes in grassland management such as widespread delays in silage cutting. Weather data indicate that rainfall in winter 2001/02 (Figure 3) and spring 2002 (Figure 4) was unusually high. In contrast, winter 2000/01 was drier and colder (Figure 5) than normal, while spring 2001 was unusually dry.

It is conceivable that overwinter survival may have been unusually low in 2000/01 due to a cold winter, while the subsequent dry spring may have led to early silage cutting and low leveret survival. Both events could have combined to result in an unusually low population of hares during the 2002 survey. The remarkably wet weather of 2002 led to widespread delays in silage cutting. This could have reduced leveret mortality and led to significantly enhanced recruitment in 2002. The higher numbers of hares recruited in 2002 then experienced typical weather conditions in 2003 and normal levels of recruitment could have led to the enhanced populations observed in this survey. It should be stressed that this is a speculative explanation,

based on a short sequence of events and limited data. It does, however, provide a basis for future investigations.

In conclusion, there is evidence from this survey of an increase in hare numbers in Northern Ireland since the last survey in spring 2002. This is not evidence of a trend or change in trend in Irish hare populations more generally. It is possible that the marked increase since the last survey is due to a sequence of climatic events and resulting changes in grassland management that may have resulted in unusually low numbers in 2002 and unusually high numbers in 2003 and 2004. There is a clear need for further work on the major factors effecting change in hare populations, focussing on large scale natural events and their interactions with agricultural practices. The state of knowledge on even the most basic aspects of Irish hare demography remains poor and requires considerable research effort in order to provide information to substantiate management actions taken to enhance the conservation status of Irish hares.

Acknowledgements

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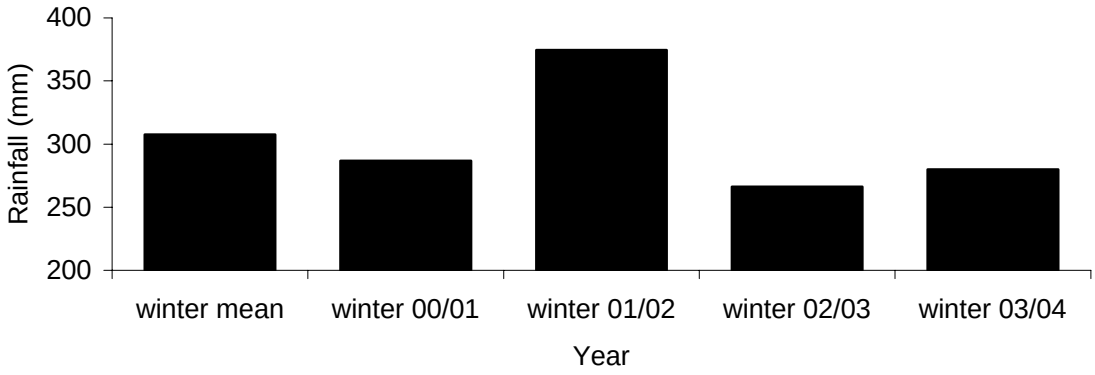

Figure 3. Recent winter rainfall compared to the 1969-1990 mean. Data from Meteorological Office (www.metoffice.com)

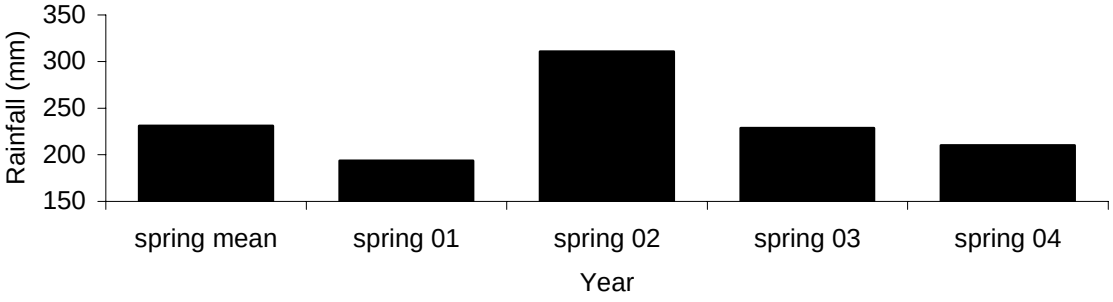

Figure 4. Recent spring rainfall compared to the 1969-1990 mean

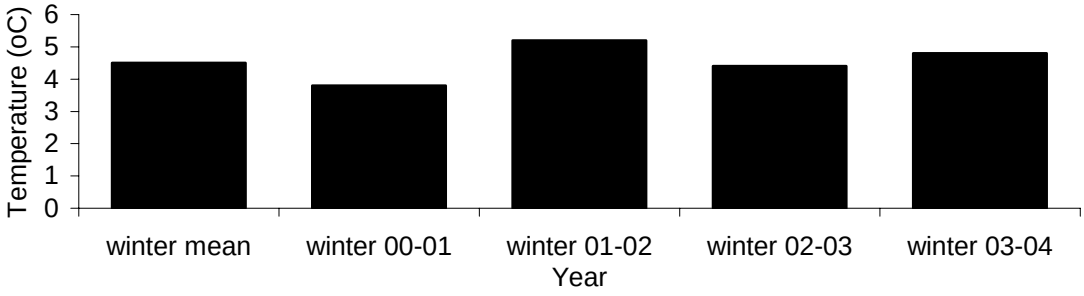

Figure 5. Recent winter temperatures compared to the 1969-1990 mean

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