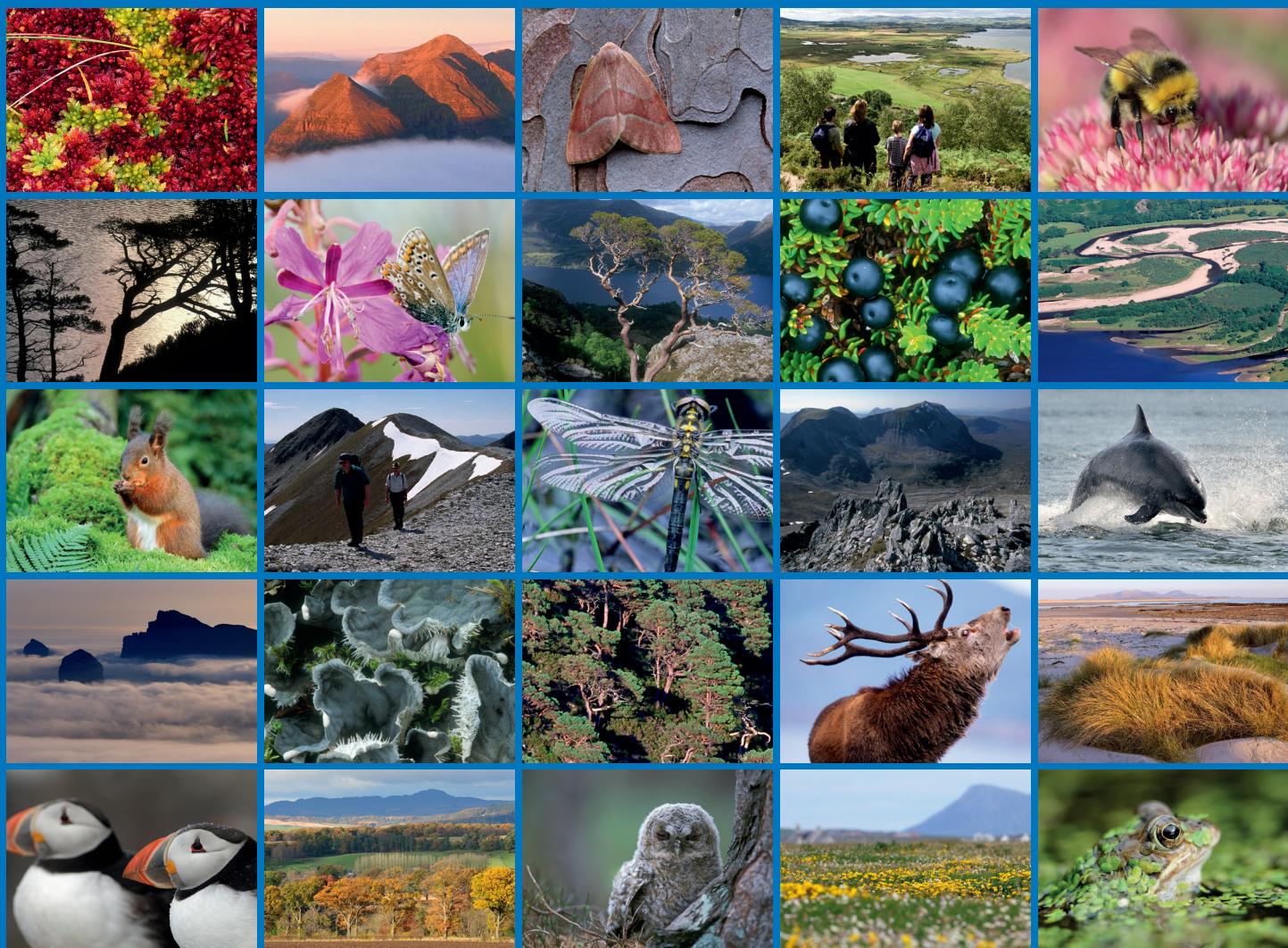


Designing a monitoring scheme for mountain hare (*Lepus timidus*) in Scotland – assessing landowner support across the Central Highlands





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RESEARCH REPORT

Research Report No. 1191

Designing a monitoring scheme for mountain hare (*Lepus timidus*) in Scotland – assessing landowner support across the Central Highlands

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RESEARCH REPORT

Summary

Designing a monitoring scheme for mountain hare (*Lepus timidus*) in Scotland – assessing landowner support across the Central Highlands

Research Report No. 1191

Project No: 115116

Contractor: SAC Consulting

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Keywords

mountain hare; monitoring; estate management; uplands

Background

In recent years there has been considerable controversy over the status of the Scottish mountain hare population, with concerns over large-scale culling in some areas and competing claims regarding population densities in these areas. However, there is relatively little scientific data available to assess the long term trends in mountain hare populations.

Widespread uptake of a standardised National Monitoring Scheme would provide a robust scientific basis for future management of this species, but is dependent on support from a wide range of land managers throughout the core range of the mountain hare. The overall aim of the current study is to determine the levels of landowner support for the National Monitoring Scheme throughout the Central Highlands through a questionnaire survey.

Main findings

- The proposed National Monitoring Scheme requires annual survey of 200 randomly selected tetrads (2km x 2km squares) spread across at least 214 private landowners as well as publicly owned land.
- A questionnaire about the scheme was circulated to 138 estates for which contact details could be found, either directly or through deer and moorland management groups. A further 34 estates involved in an existing closely-related mountain hare counting initiative run by the Game and Wildlife Conservation Trust (GWCT) were not contacted, but summary information about their ongoing monitoring was provided by GWCT.
- Responses were received from 47 estates, as well as from Forestry and Land Scotland regarding monitoring on the National Forest Estate.
- All but two respondents were willing to participate in the scheme and 25 estates indicated a willingness to undertake monitoring themselves.
- It is estimated that 55 tetrads could be monitored by estates that responded positively and that resources can be found to monitor a further 17 tetrads on public land owned by SNH and Forestry and Land Scotland.

- If monitoring being carried out by estates involved in the GWCT initiative could be incorporated into the National Monitoring Scheme, a further 39 tetrads could be covered, taking the total to 111 tetrads.
- Maximising levels of coverage is likely to require some deviation from the random allocation of tetrads, due to physical difficulties of access and issues relating to working across estate boundaries.
- The findings suggest that there is a solid base of support for a National Monitoring Scheme, but challenges remain to resource the additional survey work required, to fill gaps in coverage and to deal with methodological issues relating to the movement of randomly allocated tetrads.

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A number of individuals were very helpful in circulating the questionnaire to landowners in some parts of the project area where contact details for estates would have been otherwise difficult to find. These include: James Adamson, Savills (Secretary of West Grampian Deer Management Group), Michael Aldridge (Secretary of Glenartney Deer Management Group), Julian Clarke (Secretary of West Grampian Deer Management Group), Victor Clements (Secretary of Breadalbane Deer Management Group), Roy Dennis (Roy Dennis Wildlife Foundation), Nicola Colquhoun (Secretary of Balquhidder Deer Management Group), Jenny McCallum (JL McCallum Agricultural Consultant Ltd), Helen MacIntyre (Secretary of Inveraray and Tyndrum Deer Management Group), Shaila Rao (National Trust for Scotland), Dr Linzi Seivwright (Secretary of Strathtay Deer Management Group), Deirdre Stewart (Secretary of the South Grampian Deer Management Group), Alix Whitaker (Secretary of South Perthshire Deer Management Group) as well as colleagues from the SAC Consulting offices in Inverness, Elgin, Perth and Oban.

1. BACKGROUND

The mountain hare (*Lepus timidus*) is listed in Annex V of the EC Habitats Directive (1992), as a species 'of community interest whose taking in the wild and exploitation may be subject to management measures'. Member States are therefore required to ensure that the exploitation of Annex V species 'is compatible with their being maintained at a favourable conservation status'.

The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) requires the surveillance of the conservation status of species of Community interest. The primary objective in relation to the management of mountain hares is for the population to be managed sustainably such that the conservation status of the species is favourable.

In recent years, there has been considerable controversy over the status of the Scottish mountain hare population, with concerns over large-scale culling in some areas and competing claims (often linked to wider conflicts regarding land management in the uplands) regarding population densities in these areas. However, there is relatively little scientific information available to assess the long-term trends in mountain hare populations and to determine what the impact of culling is at a national level.

As the Non-Departmental Public Body (NDPB) whose remit is to secure the conservation and enhancement of Scotland's natural heritage, Scottish Natural Heritage (SNH) published a research report comparing a range of counting methods for mountain hares (Newey *et al.*, 2018), with the intention of providing better information on hare numbers through improved monitoring. Since then, further work has been undertaken building on this with the aim of establishing a new, bespoke national monitoring scheme (NMS) see Newey *et al.* (2020). Initially the focus of the National Monitoring Scheme is on the Central Highlands (south and east of the Great Glen) as this is where the majority of the mountain hare population occurs, but also because the recommended counting method is unlikely to be applicable in other areas, so a different approach will be required.

The proposed scheme is based on an annual survey of approximately 200 randomly generated tetrads (2km x 2km squares based on the Ordnance Survey National Grid). Within each of the tetrads, four 2km transects are walked after dark and hares are counted by spotlight. Ideally, each tetrad is counted twice each year, in the autumn. Two sets of 200 random tetrads have been generated (Figure 1): the priority tetrads are the first choice for survey if possible, with a secondary set providing alternatives for any priority tetrads that are unable to be surveyed. In addition, guidelines have been developed to allow tetrads to be moved up to 1km to avoid dangerous or unsuitable areas.

Widespread uptake of a standardised National Monitoring Scheme would provide a robust scientific basis for future management of this species, but is dependent on support from a wide range of land managers particularly in the core range of the mountain hare. In particular, the viability of the scheme is likely to depend on a proportion of the monitoring work being carried out by land managers themselves. The overall aim of the current study is to determine the levels of landowner support for the National Monitoring Scheme throughout the Central Highlands.

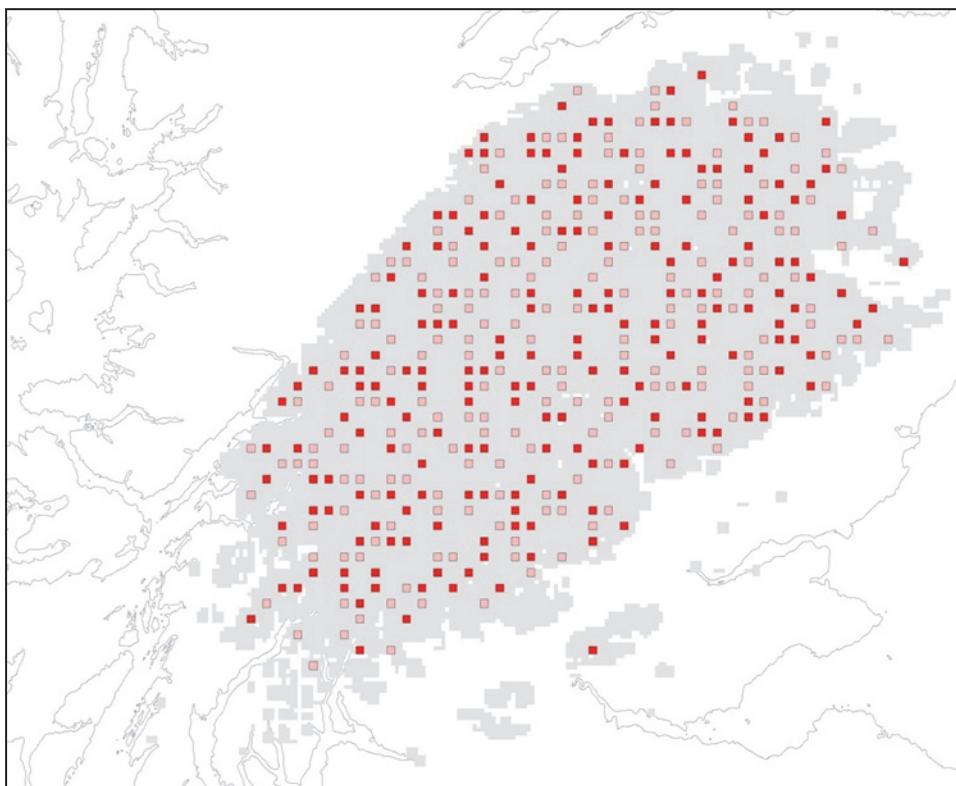


Figure 1. Proposed survey design showing 400 randomly selected survey tetrads in the Central Highlands. Priority squares are shown in red and secondary squares in pink. A secondary square would be included as a replacement where a priority square proves unsuitable for survey. (Source: SNH Research Report 1076).

2. OBJECTIVES

The overall objectives of the work covered by this project are to:

1. Quantify the number and distribution of random survey tetrads in the Central Highlands that are likely to be counted by estates;
2. Determine the proportion of these squares that may ultimately have their final positions relocated beyond the guidelines identified in the draft NMS development report;
3. Quantify the extent to which estates are prepared to commit to monitoring on an annual basis; and
4. Determine where the major gaps in coverage are, so estimates of the resource required to cover these separately can subsequently be derived by SNH.

3. METHODS

The project involved the development of a questionnaire for distribution to land managers responsible for the areas containing both the priority and secondary set of tetrads. Once the content of the questionnaire was agreed with the SNH Project Manager, the questionnaire was circulated to land managers, who were encouraged to respond. An additional complicating factor was a requirement to avoid confusion and duplication of effort with ongoing work by the Game and Wildlife Conservation Trust (GWCT) to encourage mountain hare monitoring on several estates.

3.1 Development of questionnaire

The questionnaire was developed to ask land managers four key questions:

1. Are you willing, in principle to participate in the National Monitoring Scheme for mountain hare?
2. Do you think it is practical to monitor the selected tetrads using the survey methodology?
3. Would you be able to undertake the monitoring of the required number of tetrads on your land, using your own resources?
4. Are you willing to share the count data from the tetrad surveys with SNH, on the understanding that information from the National Monitoring Scheme is likely to become publicly available?

Additional questions were added to determine whether the landowners currently carry out any monitoring of mountain hares, and indeed if they have them on their land. Background information describing the National Monitoring Scheme was provided at the start of the questionnaire. Space was also provided for landowners to add any additional information relevant to the questions.

A copy of the final questionnaire is provided in Annex 1. The questionnaire was produced as an online survey set up in ‘Microsoft Forms’. Online completion of the survey was preferred, but a fillable Microsoft Word document, which could be returned by email, was also provided for those who preferred. The Word version also allowed respondents to look over the questions before completing the online version.

3.2 Avoiding overlap with the work of GWCT

The Game and Wildlife Conservation Trust (GWCT) initiated a training programme to promote this approach to mountain hare monitoring on a number of estates during the winter of 2018/19. This used the same tetrad survey methodology recommended in SNH Research Report 1022, but the placement of tetrads was not random and was influenced by the Moorland Forum’s Principles of Moorland Management, focusing on areas where mountain hares are present and/or managed. However, the potential value of these counts as contributing to SNH’s National Monitoring Scheme (NMS) is being considered and GWCT has carried out an analysis of the degree of overlap with NMS tetrads.

In order to avoid confusion and duplication of effort, the estates that are involved in the GWCT initiative were excluded from the questionnaire survey to assess landowner support for the NMS. GWCT Scotland helpfully provided a list of the estates involved in their monitoring project to ensure that they were not contacted (although a small number received the questionnaire via deer management group mailing lists). GWCT also shared summary information about their project which helped to assess its potential contribution to the NMS.

3.3 Circulation of questionnaire

The circulation of the questionnaire to the 200+ landowners with priority or secondary tetrads on their land was the largest challenge of this project. There is no single source of contact details for landowners and while many estates have a prominent online presence through which contact details can be found, there is virtually no publicly available contact information for a significant number of estates.

Much of the area covered by the proposed National Monitoring Scheme is also covered by deer management groups and these were used as a first point of contact, particularly for the western parts of the area. Using contact details from www.deer-management.co.uk, secretaries of deer management groups were asked to circulate the questionnaire to their members and nine of the groups were able to do this. In the north-east, the need to avoid overlap with the GWCT work (see Section 3.2) meant that deer management groups were not used in this area.

In areas where deer management groups were unable to help or which were not in deer management groups, estates were contacted indirectly through moorland management groups and other contacts known to work with estates in particular areas, or were contacted directly using contact details derived from a variety of sources. These included online searches and local knowledge of SAC Consulting offices.

When the questionnaire was circulated it was accompanied by map(s) tailored to the local area showing the location of priority and secondary tetrads. This allowed respondents to give an opinion on the practicality of these randomly selected squares.

The first questionnaires were circulated in early July 2019 through deer management groups in areas that were known not to be involved in the GWCT work (primarily in the south-west part of the area). Once the details of those estates involved in the GWCT work were known, estates in other areas were contacted between mid-August and mid-September, with a small number of outstanding landholdings being contacted in later September and early October. The response rates from the initial invitations to complete the questionnaire were generally quite low, although some estates responded very quickly. The first set of invitations sent in July also coincided with the onset of the main summer holiday period. As a result, much of the questionnaire exercise was conducted later than originally envisaged. E-mailed reminders were sent out, typically two or three weeks after the initial questionnaire, and these reminders triggered a number of additional responses in most areas.

A number of the tetrads were located on publicly-owned land, primarily Forestry and Land Scotland, but also SNH and Highlands and Islands Enterprise. SNH has been assessing its capacity to implement the monitoring scheme on its own land internally and so these areas were excluded from the questionnaire survey. Potential for monitoring on the National Forest Estate was dealt with through a single point of contact at Forestry and Land Scotland. The single landholding of Highlands and Islands Enterprise was treated in the same way as private landowners for the purposes of this project.

4. RESULTS

The National Monitoring Scheme tetrads are spread across approximately 214 estates within the Central Highlands. The questionnaire survey was sent to 138 estates for which contact details could be found, and excluding 34 estates involved in the GWCT initiative. A total of 47 estates responded, of which 45 provided positive or supportive responses.

4.1 The GWCT initiative

Information provided by GWCT indicated that a total of 47 estates are participating in the GWCT initiative and a total of 62 monitoring tetrads were established during the winter of 2018/19. However, some of these are in the southern uplands, outwith the central Highlands area covered by the proposed National Monitoring Scheme. A total of 37 estates and at least 55 tetrads were established within the area covered by the NMS.

Using the information provided by GWCT, it was possible to determine that 48 priority and 50 secondary NMS tetrads (25% of the total) are located at least partially on estates involved with the GWCT initiative (Table 1). However, this included tetrads which overlapped only marginally and a total of 35 priority and 30 secondary tetrads were substantially (>75%) located on those estates working with GWCT. The total combined area of the parts of tetrads (including whole tetrads) that lie within the estates involved in the GWCT initiative is equivalent to 39 priority and 35 secondary tetrads.

Table 1. The number of National Monitoring Scheme tetrads that overlap by different percentages with estates involved in the GWCT initiative.

	Priority Tetrads (total=198)	Secondary Tetrads (total=200)
100% on GWCT estates	31 (15.7%)	24 (12.0%)
75-99% on GWCT estates	4 (2.0%)	6 (3.0%)
50-74% on GWCT estates	6 (3.0%)	5 (2.5%)
25-49% on GWCT estates	2 (1.0%)	6 (3.0%)
0-24% on GWCT estates	5 (2.5%)	9 (4.5%)
Total	48 (24.2%)	50 (25.0%)

This suggests that the number of tetrads being monitored through the GWCT initiative exceeds the numbers required for the National Monitoring Scheme over the same areas of land. To determine how the distribution of tetrads in the areas covered by GWCT relates to the random distribution proposed for the National Monitoring Scheme, GWCT carried out an analysis of overlap on 55 tetrads within their area of coverage, and this is reproduced below with their permission (Figure 2).

Of these 55 tetrads, 10 tetrads overlapped at least partially with priority NMS tetrads and seven with secondary NMS tetrads. A further four tetrads were at least partially adjacent to priority NMS tetrads and three were adjacent to secondary NMS tetrads. Sixteen tetrads were up to 1km away from a priority NMS tetrad and seven up to 1km from a secondary NMS tetrad. Only three of the 55 surveyed tetrads are more than 2km from the nearest NMS tetrad.

A more detailed analysis of the extent to which the GWCT project tetrads could potentially contribute to the National Monitoring Scheme is not possible without knowledge of the exact location of the tetrads and the extent to which deviation from the random distribution shows bias towards particular habitats. In addition, agreement is needed regarding data sharing.

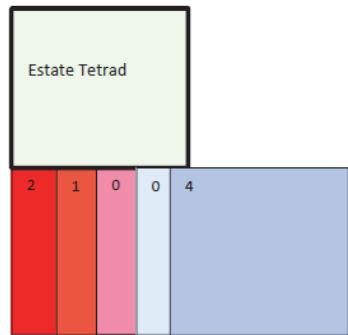
Overlap of area

100%	60%	50%	25%	<20%
2 (1P, 1S)	2 (2P)	4 (3P, 1S)	3 (2P, 1S)	6 (2P, 4S)



Estate adjacency to NMS tetrad

100%	75%	50%	25%	<20%
2 (1P, 1S)	1 (1P)	0	0	4 (2P, 2S)



Estate proximity to NMS tetrad

Up to 1km separation	Up to 2km	2km+	3km	>3km
23 (16P, 7S)	5 (4P, 1S)	1 (1P)	1 (S)	1 (1S)



Figure 2. Overlap of tetrads monitored by estates in the GWCT initiative with proposed National Monitoring Scheme tetrads. P= Priority tetrad, S= Secondary tetrad. Figure reproduced by kind permission of Game and Wildlife Conservation Trust Scotland.

4.2 Publicly-owned land

The majority of tetrads on publicly-owned land are on the National Forest Estate, with a small number (3 priority and 4 secondary) at least partially on land owned by Scottish Natural Heritage. SNH has identified five tetrads on or adjacent to its own land that it will be able to monitor,

Only a very small number of tetrads are fully within the National Forest Estate (1 priority and 4 secondary tetrads), but the total combined area of the parts of tetrads (including whole tetrads) that lie within the National Forest Estate is equivalent to 11.8 priority tetrads and 15.7 secondary tetrads (Table 2).

Forestry and Land Scotland is willing to support the scheme on the following terms:

1. Forestry and Land Scotland will facilitate access for surveyors on to the national forests and land.
2. Forestry and Land Scotland does not have sufficient staff resource to carry out monitoring in-house, and there are complications associated with FLS staff working on private ground.
3. Forestry and Land Scotland is prepared to make a financial contribution to the scheme and will consider a proportional contribution to the monitoring costs of tetrads that are

50% or more on FLS land. This amounts to 12 priority or 15 secondary tetrads, the total area of which falling within the National Forest Estate is equivalent to 8.9 - 11.4 full tetrads.

Table 2. The number of National Monitoring Scheme tetrads that overlap by different percentages with the National Forest Estate.

	Priority Tetrads (total=198)	Secondary Tetrads (total=200)
100% on NFE	1 (0.5%)	4 (2.0%)
75-99% on NFE	5 (2.5%)	2 (1.0%)
50-74% on NFE	5 (2.5%)	9 (4.5%)
25-49% on NFE	5 (2.5%)	9 (4.5%)
0-24% on NFE	11 (5.6%)	15 (7.5%)
Total	27 (13.6%)	39 (19.5%)

Where access to adjoining land by surveyors is not possible, it may be necessary to consider moving tetrads so that they are wholly or substantially within the National Forest Estate. This is particularly problematic as it could have the effect of biasing survey squares towards areas that are more likely to be forested. However, this may be minimised by ensuring the total number of tetrads surveyed on the National Forest Estate falls within the range of 12-16 that was allocated randomly.

4.3 Extent of questionnaire coverage

4.3.1 By landowner

It is estimated that the priority tetrads that were randomly selected for the National Monitoring Scheme are distributed across 143 private landholdings and land owned by two non-governmental organisations (a small number of tetrads also include farmland split between multiple landholdings that could not be accurately counted). This is in addition to the public landholdings considered in Section 4.2 that contain tetrads.

Of the 145 non-public landowners, 26 are involved in the GWCT initiative (see below) and were not contacted; 64 were contacted through deer management or moorland management groups and 31 were contacted directly and asked to complete the questionnaire. Together these account for 83% of landowners with priority tetrads.

The allocation of secondary tetrads is distributed across many of the same landholdings, but also includes an additional 69 private landholdings and one additional non-governmental organisation. Of these, eight were involved in the GWCT initiative, 32 were contacted through deer management or moorland management groups and 11 were directly contacted. Together these account for 74% of the additional secondary landowners. The lower contact rate is largely due to the fact that landholdings with only secondary tetrads tend to be smaller and are more likely to contain only partial tetrads. Overall, priority and secondary tetrads combined are distributed across approximately 214 non-public landowners, of which 172 (80%) have been contacted through this survey or are involved in the GWCT initiative.

The main areas where no contact has been possible are generally on the fringes of the upland area, where fragmentation of landownership makes it difficult to identify landowners and in one area where contact via the local deer management group was not possible. For the most part these landholdings contained farmland and forestry and are not prime mountain hare habitat. It is estimated that the number of tetrads with suitable habitat that are on landholdings that could not be contacted amount to less than 5% of the total number of tetrads.

4.3.2 By tetrad

The level of contact through this survey in terms of the number of priority and secondary tetrads covered is shown in Table 3. Many tetrads that straddle property boundaries fall into more than one of the row categories used in this table, so the dominant one (usually accounting for >50% of the tetrad) is used. A small number of the tetrads listed as having no contact include areas that are included in other categories (particularly areas on the National Forest Estate) but in all cases these amounted to less than 25% of the tetrad area.

Table 3. The number of priority and secondary tetrads whose landowners have been contacted and invited to complete the survey questionnaire on the national monitoring scheme.

	Priority	Secondary
GWCT initiative	42 (21.2%)	35 (17.5%)
Contacted	129 (65.2%)	139 (69.5%)
No contact	27 (13.6%)	26 (13.0%)

4.4 Summary of questionnaire responses

4.4.1 By landowner

A total of 47 non-public landowners responded to the questionnaire. This represents 34% of those contacted, and 26% of those non-public landowners with tetrads on their land and not currently involved with the GWCT project. The largest gaps in responses came from the western edge of the area and particularly in those areas dominated by high, steep and rocky mountains.

In response to the question “*Are you willing, in principle and with no binding commitment at this stage, to participate in the national monitoring scheme for mountain hare on the area of land that you manage?*”, four out of the 47 respondents answered ‘no’. However, two of these indicated that they would be willing to participate if only they had mountain hares on their land and provided contact details and indicated that they were willing to be contacted by project staff at a later date. In practice, these two respondents should probably be considered as willing to participate in principle. The two estates that clearly indicated that they did not wish to be contacted further each contained less than half of one tetrad.

This highlights an aspect of the random survey methodology that should probably have been made clearer to respondents, namely that the scheme should not just target areas where mountain hares are present in good numbers.

A total of 32 of the 47 respondents were certain that they have mountain hares on their ground and nine thought that they did not. Estates that said they did not have mountain hares on their land tended to be concentrated in the south-west part of the Central Highlands, particularly Argyll, but even here several estates indicated that they did occasionally see hares, and one commented that the recent use of thermal imaging cameras had indicated that there may be more present than they had previously thought.

Seven estates indicated that they currently monitor mountain hares, mostly by ad-hoc recording of observations or alongside annual grouse counts. One estate indicated that they currently use the methodology recommended for the National Monitoring Scheme and two indicated that they are about to start using the methodology.

In response to the question “*Would you be able to undertake the monitoring of the required number of tetrads on your land, using your own resources?*” a total of 25 respondents

answered yes and a further two were unsure but indicated that they were willing to consider undertaking monitoring.

Four respondents stated that they were not willing to share data with SNH. These were all respondents who had also said that they were unable to undertake the monitoring themselves.

Based on questionnaire responses and additional discussion with some estates, seven respondents suggested that tetrads may need to be moved to facilitate access or due to the danger of working on the terrain at night. In addition, six respondents indicated that they would be unwilling to survey tetrads that cross the boundary into neighbouring landholdings.

4.4.2 By tetrad

The number of tetrads for which responses have been received from non-public landowners is shown in Table 4, sorted by the proportion of the tetrad covered by the response. While responses have been received for 65 priority and 66 secondary tetrads, only 39 priority and 48 secondary tetrads are substantially (>75%) within the landholdings from which responses have been received.

From the respondents who expressed a willingness to undertake monitoring work, there were suggestions to move at least 12 out of 74 (16.2%) tetrads that were more than 75% covered by responses. For those tetrads that were only 25-75% covered by a response, there were requests to move six out of 23 such tetrads (26%). These figures for relocating tetrads should be considered to be a minimum. A small number of estates expressed a willingness to co-operate across boundaries to monitor tetrads, but in most cases, the neighbouring estate did not respond to the questionnaire. Some of those tetrads might need to be moved to maximise coverage if agreement to survey is not reached with the neighbours. In addition, it is likely that some estates (particularly larger ones with multiple tetrads) may look more closely at tetrad placement if the decision is taken to fully implement the monitoring scheme.

It is likely that a higher level of landowner contribution to the national monitoring scheme can be achieved by moving tetrads to accommodate landholding boundaries, provided this could be achieved without significantly compromising the benefits of random tetrad allocation.

An individual evaluation of the tetrads on each estate that responded suggests that up to 55 tetrads could be surveyed by the estates that have expressed willingness to carry out survey work, without duplication of priority and secondary tetrads in the same area, if some small-scale movement of tetrads to accommodate estate boundaries is permitted. Approximately 14 additional tetrads could be located on estates that are willing to participate but unable to carry out survey work themselves.

Table 4. Number of tetrads for which a response has been received from non-public landowners, and the proportion of the tetrad covered by the response

	Percentage of tetrad covered		
	>75%	25-75%	<25%
Priority tetrads			
Landowner responded to questionnaire	39	21	5
Landowner willing to participate in scheme	39	21	5
Landowner willing to undertake survey work	33	17	2
Secondary tetrads			
Landowner responded to questionnaire	48	12	6
Landowner willing to participate in scheme	48	11	6
Landowner willing to undertake survey work	41	6	4

5. DISCUSSION

The findings of the questionnaire survey indicate that there is potential for at least 55 tetrads to be monitored by non-public landowners in the Central Highlands. In addition, resources are likely to be available from Forestry and Land Scotland and SNH to support monitoring on about 17 tetrads on publicly-owned land, giving a total of 72 tetrads. Through the GWCT initiative, estates that cover approximately 39 National Monitoring Scheme tetrads are currently monitoring more than this number of tetrads using the same methodology, but not using the same randomly selected tetrads. If the survey effort by these estates could be incorporated into the National Monitoring Scheme and the resultant count data made available to SNH, at least 111 tetrads would be covered; just over half of the total number of tetrads recommended for the National Monitoring Scheme.

This would provide a solid base for the development of a National Monitoring Scheme, but significant challenges remain. The first major challenge is how best to integrate those estates already working with GWCT into the NMS. This would require agreement from the estates involved to share their data with SNH as well as ensuring that the monitored tetrads meet the randomly allocated pattern required by the NMS. At present it is likely that many of the tetrads being monitored on these estates are in areas where hares are controlled, meaning that they may be biased towards areas that are capable of supporting high densities of hares. While many of these tetrads may be close to those randomly selected for the NMS, it is possible that monitoring of additional tetrads will be required. The extent to which estates might be able to deliver this will depend on resources available and other factors such as any requirements that might arise from the review of grouse moor management.

To maximise tetrad coverage amongst estates in general, and on public land, it is likely that a significant number of tetrads (perhaps at least 16-26%) might need to be moved from their initial allocation, not just to avoid high risk survey areas, but also to avoid overlapping estate boundaries in many cases. Moving tetrads is not ideal as it deviates from the random design of the monitoring scheme. However, it is possible that there is a choice to be made between an achievable monitoring scheme that deviates somewhat from the methodological ideal and an ideal monitoring scheme that is difficult to achieve. There would then be a requirement to determine the extent to which deviation from purely random tetrad allocation can be controlled for. Land cover datasets might provide a way of assessing the extent to which monitored tetrads reflect land cover in the wider area.

The extent to which estates will be willing to commit to monitoring on a year-by-year basis is difficult to quantify in a questionnaire survey. Circumstances could change on individual estates meaning that resources are no longer available to commit to monitoring. It is also possible, particularly in areas of very low hare density, that initial enthusiasm for monitoring will wear off, after a year or two of transects delivering very low or zero counts. It is important that the National Monitoring Scheme considers the possibility of future loss of interest in some areas and how that could be dealt with.

Further significant challenges within the Central Highlands monitoring area are to address the gaps in coverage, to find the resources to monitor the other half of the tetrads that the methodology requires and to gain permission to monitor tetrads on estates that have not responded.

There are many reasons why estates may not have responded to the questionnaire survey, apart from not wanting to be involved. It may be that mountain hares are a low priority, or that they are present in such low numbers that there did not seem to be any point in responding, or simply that the estate manager was too busy to respond at the time. It is possible that some of those who did not respond would not object to a third party carrying

out monitoring work, subject to agreement. If a decision is made to proceed with a National Monitoring Scheme it is likely that liaison with networks such as Deer Management Groups and Moorland Management Groups will be essential to facilitate access. It is possible that further contact may also encourage some additional landholdings to undertake monitoring themselves if they see their neighbours doing it.

There are likely to be some areas where it will remain very difficult to implement the National Monitoring Scheme, due to the difficulties and dangers of trying to carry out transects in the dark on very steep and rocky ground. In most of the Central Highlands, such terrain is relatively localised, but there is a significant contiguous area in the west where the methodology is unlikely to be achievable. This area lies to the west of Rannoch Moor and Loch Treig and is bounded by the A86 road to the north and the A85 road to the south. This area includes the mountains of Ben Nevis, the Grey Corries, Mamois, Glencoe and Glen Etive.

While there is evidence of a solid base for the National Monitoring Scheme, it may not be possible to implement it fully from the outset. Consideration will therefore need to be given to how gaps in coverage might be filled in gradually, and how this will affect the quality and usefulness of the data generated by the scheme initially.

6. RECOMMENDATIONS

If the decision is taken to implement a National Monitoring Scheme for mountain hares on the scale proposed, SNH will need to consider the financial resources available to fill gaps in coverage. Other key recommendations are:

1. Continue dialogue with GWCT to explore the potential for their initiative to contribute to the National Monitoring Scheme.
2. Maintain contact with those landowners who have responded positively to the questionnaire to ensure that they are kept aware of how the proposals for the National Monitoring Scheme are progressing.
3. Offer training on the monitoring methodology to those who have responded positively to the questionnaire, and extend the invitation through deer or moorland management groups to other estates who may not have responded.
4. Consider asking deer or moorland management groups if it is possible to speak to group meetings about the scheme to seek access for monitoring areas that have not responded to the questionnaire.
5. Seek scientific advice on the impacts of deviating slightly from random tetrad allocation, particularly where estate boundaries create difficulties, and to investigate if this could be controlled for.
6. Seek scientific advice on the impacts of filling in gaps in coverage gradually if financial or practical access constraints prevent full implementation from the start.

7. REFERENCES

Newey, S., Fletcher, K., Potts, J. & Iason, G. 2018. Developing a counting methodology for mountain hares (*Lepus timidus*) in Scotland. Scottish Natural Heritage Research Report No. 1022.

Newey, S., Potts, J., Aebischer, N.J., Wilson, M.W. & Newson, S.E. 2020. Designing a monitoring scheme for mountain hare (*Lepus timidus*) in Scotland. Scottish Natural Heritage Research Report No. 1076.

ANNEX 1: LANDOWNER QUESTIONNAIRE

Background information

Mountain hares are protected under European legislation such that any exploitation of hares '*is compatible with their being maintained at a favourable conservation status*', i.e. they are managed sustainably. The available information on mountain hare populations comes from several sources, but none of these were specifically designed to monitor mountain hare numbers. Given the claims and counter-claims about the status of mountain hares, there is a need for a comprehensive, bespoke national monitoring scheme designed specifically for this species.

If you do currently manage mountain hares it is important that your management efforts are considered. Specifically, if you are culling them, it is to be assumed that you are undertaking some degree of counting and we would like to see how your counting could contribute to a national scheme.

If you do not actively manage mountain hares we are still interested in understanding whether you would be willing to contribute to understanding how mountain hares are doing across the Central Highlands.

The mountain hare national monitoring scheme involves surveying a sample of 2km x 2km ordnance survey grid squares (called tetrads) throughout the range of the mountain hare in the Central Highlands¹. Ideally it will also provide valuable local population information to individual estates with an interest in mountain hares. The primary aim of this questionnaire is to gauge the level of land manager support for the scheme, both in principle and in terms of enabling the delivery of the survey work on the ground.

Selection of tetrads

Approximately 200 tetrads have been randomly (i.e. no practical assessment of the ground has been made) selected as priorities for survey. These are marked in blue on the map(s) accompanying this questionnaire. Ideally the monitoring scheme should use these tetrads as far as possible, but it is appreciated that there may be practical difficulties and part of the aim of this questionnaire and follow-up work is to identify where changes to the priority tetrads will be necessary.

Some tetrads are in very remote or dangerous areas (steep slopes etc.) which may not be safe to survey. Some may contain significant areas of water or major roads. Adjusting the tetrads to be surveyed is most likely to be necessary in these situations.

Many of the selected tetrads straddle property boundaries to a greater or lesser extent. Ideally land managers will co-operate to ensure these tetrads are surveyed. However, it is appreciated that in some cases this may not be possible and adjustment of the tetrad may be required.

Due to the randomness of the selection process, some tetrads include habitats that are less suitable for mountain hares, such as woodland or farmland. However, in most cases these

¹ Other counting methods will be required elsewhere in the mountain hare's range.

should still be surveyed as simply selecting areas that are perceived as ‘good’ for mountain hares will skew the results and reduce the robustness of the data.

The process for moving priority tetrads involves initially looking to see if it is possible to move the tetrad a short distance (up to 1km) in different directions. If this is not possible a nearby tetrad from a previously selected secondary set of random tetrads should be considered. This secondary (alternative) set is shown in orange on the accompanying map(s).

Survey method

The methodology was developed by scientists from the James Hutton Institute and the Game and Wildlife Conservation Trust (GWCT) and is described in [SNH Research Report 1022](#) - Developing a counting methodology for mountain hares (*Lepus timidus*) in Scotland.

Within each of the tetrads, four 2km transects are walked after dark and hares are counted by spotlight.

We estimate that each of the four transects should take 1-1½ hours and completion of the survey of each tetrad should therefore take around 6 hours, not including the time required to access the survey area.

Ideally, each tetrad is counted twice each year, in the autumn.

It is anticipated that surveys will be carried out annually and therefore ideally require a long-term commitment. The questionnaire should be completed on the basis of current circumstances. However, it is fully accepted that circumstances may change and that estates may not be able to guarantee to be able to deliver monitoring indefinitely into the future.

Data Protection and Confidentiality

Information collected from this questionnaire will be held securely and handled in compliance with data protection regulations.

Responses from individual estates, including personal information such as contact details will only be available to staff working on the mountain hare national monitoring scheme project and will only be used for the purposes of that project.

Information collected from the questionnaire that might be made publicly available would be limited to summaries of the overall responses to the questions and will not be identifiable to individual landholdings.

SAC Consulting is a division of SRUC (Scotland’s Rural College). [SRUC Data Protection Policy](#)

[SNH Data Protection Policy](#)

QUESTIONNAIRE

1. Name of Estate/Landholding:

Click or tap here to enter text.

2. Do you have mountain hares on your land?

Choose an item.

3. Do you currently count mountain hares on your land?

Choose an item.

4. If yes, please provide an indication of the method used:

Click or tap here to enter text.

5. If yes are you willing to look at how your counting could overlap with the proposed NMS?

Choose an item.

6. Are you willing, in principle, and with no binding commitment at this stage, to participate in the national monitoring scheme for mountain hare on the area of land that you manage?

Choose an item.

7. Please add any comments on questions 1-6 here:

Click or tap here to enter text.

An indication of the location of tetrads likely to fall on your land is provided in the map(s) that were sent with the link to this questionnaire. Priority tetrads are shown in blue and are the first choice for monitoring, but could be moved up to 1km if necessary. Secondary tetrads are shown in orange and could be used instead of a nearby priority tetrad that is unsuitable. Please consider both sets of tetrads when answering these questions even though the final selection will not include all tetrads from both sets.

8. Do you think it is practical to monitor these tetrads using the methodology described?

Choose an answer.

9. Would you be able to undertake the monitoring of the required number of tetrads on your land, using your own resources? Answering yes at this stage will not be taken as a binding commitment.

Choose an answer.

10. Are you willing to share the count data from the tetrad surveys with SNH, on the understanding that information from the national monitoring scheme is likely to become publicly available? No information on land ownership or associated contact information will be made public.

Choose an item.

11. Please add any comments on questions 8-10 here:

Click or tap here to enter text.

12. If you have indicated that you are willing, in principle to participate in the national monitoring scheme, are you content to be contacted by project staff to discuss the project in further detail?

Choose an item.

13. Contact details:

Click or tap here to enter text.

14. Do you have any other points you like to make about how best to monitor mountain hares in your area?

Click or tap here to enter text.

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