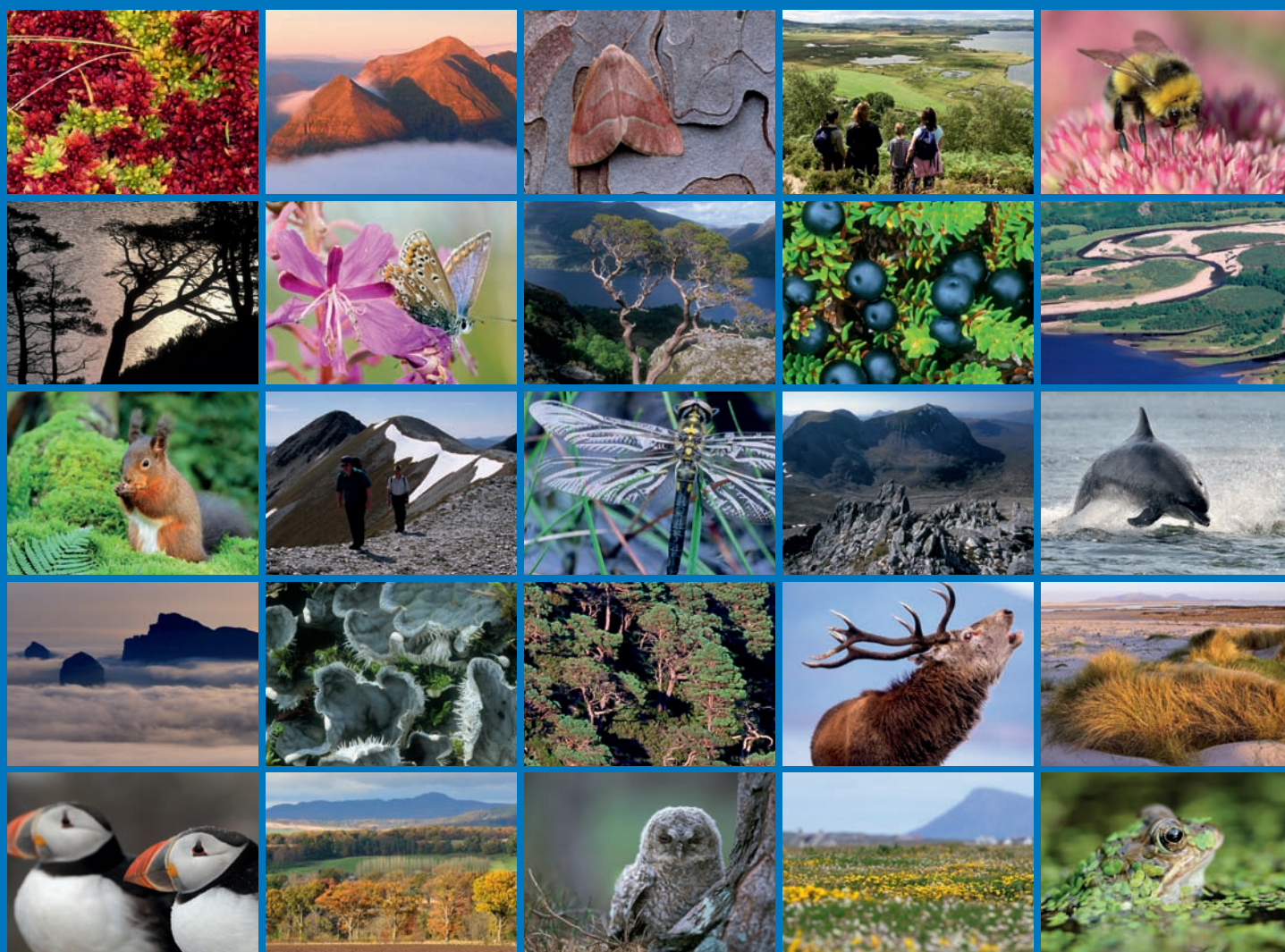


Assessment of herbivore impacts at Kentra Bay and Moss SSSI



RESEARCH REPORT

Research Report No. 1185

Assessment of herbivore impacts at Kentra Bay and Moss SSSI

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RESEARCH REPORT

Summary

Assessment of herbivore impacts at Kentra Bay and Moss SSSI

Research Report No. 1185
Project No: 117136
Contractor: Andy Acton
Year of publication: 2020

Keywords

Claish Moss and Kentra Moss SAC; blanket bog; Lochaber; Ardnamurchan DMG.

Background

This report describes the results of a herbivore impact assessment (HIA) of Bog habitats undertaken at Kentra Bay and Moss SSSI in summer 2018.

Main findings

- Herbivore impacts were assessed at 28 plots.
- Twenty six percent of samples were assessed as subject to Chronic Heavy grazing and 67% of samples were subject to either Chronic High or Chronic Moderate grazing.
- Four percent of samples are currently subject to High grazing impacts, with 36% subject to Medium-High grazing impacts, and 54% to Medium grazing impacts.
- Eighteen percent of samples are currently subject to High trampling impacts, with 25% subject to Medium-High trampling impacts.
- Four percent of samples are currently subject to High dunging impacts, with 22% subject to Medium-High dunging impacts, 26% to Medium impacts and 41% to Low impacts.
- The main concerns are the trampling impacts on the bog at Kentra Moss which are in some areas disrupting the *Sphagnum* lawns especially those around the edges of bog pools. This includes damage to some of the more important areas of the bog which exhibit good patterning with abundant linear bog pools.
- Sheep and Red deer both range widely over the bog, but the relative contribution of each to the trampling damage is unclear. There were no signs of recent cattle grazing.
- It is recommended that trampling impacts are reduced and that the trampling impacts should be subject to regular monitoring.

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1. INTRODUCTION

1.1 Background

Kentra Moss is part of both Kentra Bay and Moss SSSI and Claish Moss and Kentra Moss SAC. Further blanket bog in the southwest of the SSSI is not included in the SAC.

In 2006 the bog habitat at Kentra Bay and Moss SSSI failed cycle-2 site condition monitoring (SCM) targets due to high herbivore impacts (SNH, 2006), but the 2014 cycle-3 SCM of bog habitats at Claish Moss and Kentra Moss SAC recorded low impacts at Kentra Moss (Wells, 2015). The purpose of this survey is to obtain information that will allow SNH and land managers to monitor progress towards condition objectives for blanket bog at Kentra Bay and Moss SSSI.

The objectives of the proposed work are to:

- assess current grazing and trampling impacts from herbivores on the bog habitat at Kentra Bay and Moss SSSI, and the direction of any apparent trends in impact levels.
- use fixed point digital photography to capture images of the sample plots: and
- provide a prognosis for habitat condition based on the survey.

2. METHODS

2.1 Plot selection

Potential plot locations within the blanket bog of Kentra Bay and Moss SSSI were generated randomly by SNH using vegetation maps. Vegetation maps often include mosaic polygons with more than one habitat type, so generation of random sample plots using GIS may result in habitat types forecast at potential plot locations being different than those found on the ground (within 20m of the grid reference of the potential plot location). In this situation the potential plot location is discarded and the surveyor moves to the next potential plot location. Twenty-eight bog plots were to be surveyed at Kentra, so SNH provided 37 potential plot locations in order to allow for potential plot locations discarded during survey.

The grid reference for the plot is recorded on the recording spreadsheet (Annex 3). Grid references denote the SW corner of the plot, which, is orientated N-S and E-W with the National Grid (i.e. magnetic bearings are converted to Grid bearings). Plot size is generally 4 m² (2 m x 2 m) except for dung which is assessed at a 10 m by 10 m plot centred on the smaller plot.

Two digital photographs were taken at each plot location. One is a context shot to illustrate plot location within the wider landscape, and the other is a closer view to show the vegetation in the plot.

2.2 Assessment of indicators

Standardised methods for assessing herbivore impacts on upland habitats (MacDonald *et al.* 1998, MacDonald 2007) were used to assess current grazing and trampling impacts and impact trends on the target habitat. A number of quantitative indicators were also assessed.

Full details of the HIA methods to be used are presented in Annex 1. The appropriate small-scale grazing, trampling and dung indicators (Annex 2) were recorded for each plot. The classes used were Low (L), Medium (M), and High (H), with intermediate classes (LM, MH) only used if necessary (see MacDonald 2007 section 11).

2.3 Deriving impact classes for each plot

The results for individual small-scale field indicators for each plot were combined to produce impact classes for each plot. Overall impact classes (derived by combining results for all indicators) can mask important differences between grazing and trampling impacts, and therefore indicators were combined in groups to give separate assessments of grazing and trampling.

The impact class was derived from the median (middle value) of the scores for the indicators assessed. If there was an even number of indicators and the scores for the two middle values were different, the intermediate of the two middle values was taken.

2.4 Constraints

Difficulties, with particular features, attributes or targets are listed below

- Sometimes a 2x2 m plot did not pick up any appreciable trampling impact despite frequent animal tracks in the 10x10 m plot. *Trampling & grazing of pool systems & water tracks* and the abundance of hoof prints were recorded in the 10x10 m dung plot as well as in the 2x2 m plot to facilitate assessments in cases of doubt.
- MacDonald *et al.* (1998) acknowledge that sometimes indicators do not always distinguish between all classes of impact. For trend classes Chronic High-Chronic

Moderate should be interpreted to indicate that based on the indicators, the trend could not be allocated with confidence to either Chronic Moderate or Chronic Heavy.

- No trampling trends were discernible from the data collected. These would be best assessed through regular repeat monitoring.
- It was often difficult to distinguish between sheep and Red deer dung.

On balance it was considered that none of the above constraints precluded an assessment of the herbivore impacts.

3. RESULTS

3.1 Herbivore impacts

One plot (4% of samples) is currently subject to High grazing impacts, with 36% of samples (10 plots) subject to Medium-High impacts, and 54% to Medium grazing impacts (Table 1). 18% of plots (5 plots) are currently subject to High trampling impacts, with 25% (7 plots) subject to Medium-High impacts. Twenty six percent of plots had High or Medium-High dunging impacts, 26% Medium impacts and 41% Low dunging impacts. The grazing, trampling and dunging impacts in each plot are illustrated in Figures 1-3.

Table 1. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

Indicators	Impact Class				
	High	Medium-High	Medium	Medium-Low	Low
Grazing	4 (1)	36 (10)	54 (15)	7 (2)	0
Trampling	18 (5)	25 (7)	29 (8)	18 (5)	11 (3)
Dunging	4 (1)	22 (6)	26 (7)	11 (3)	41 (11)

3.2 Grazing impact trends

Twenty six percent of samples (7 plots) were assessed as subject to Chronic Heavy browsing and 67% of samples (18 plots) were assessed as having Chronic High-Chronic Moderate grazing (Table 4). The grazing impact trends for each plot are shown in Figure 4.

Table 2. Grazing impact trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

Indicator	Impact Trend				
	Chronic High	Chronic High-Chronic Moderate	Chronic High-Chronic Moderate (Decreasing?)	Chronic Moderate	Unallocated
Grazing	25.9 (7)	66.7 (18)	3.7 (1)	3.7 (1)	3.7 (1)

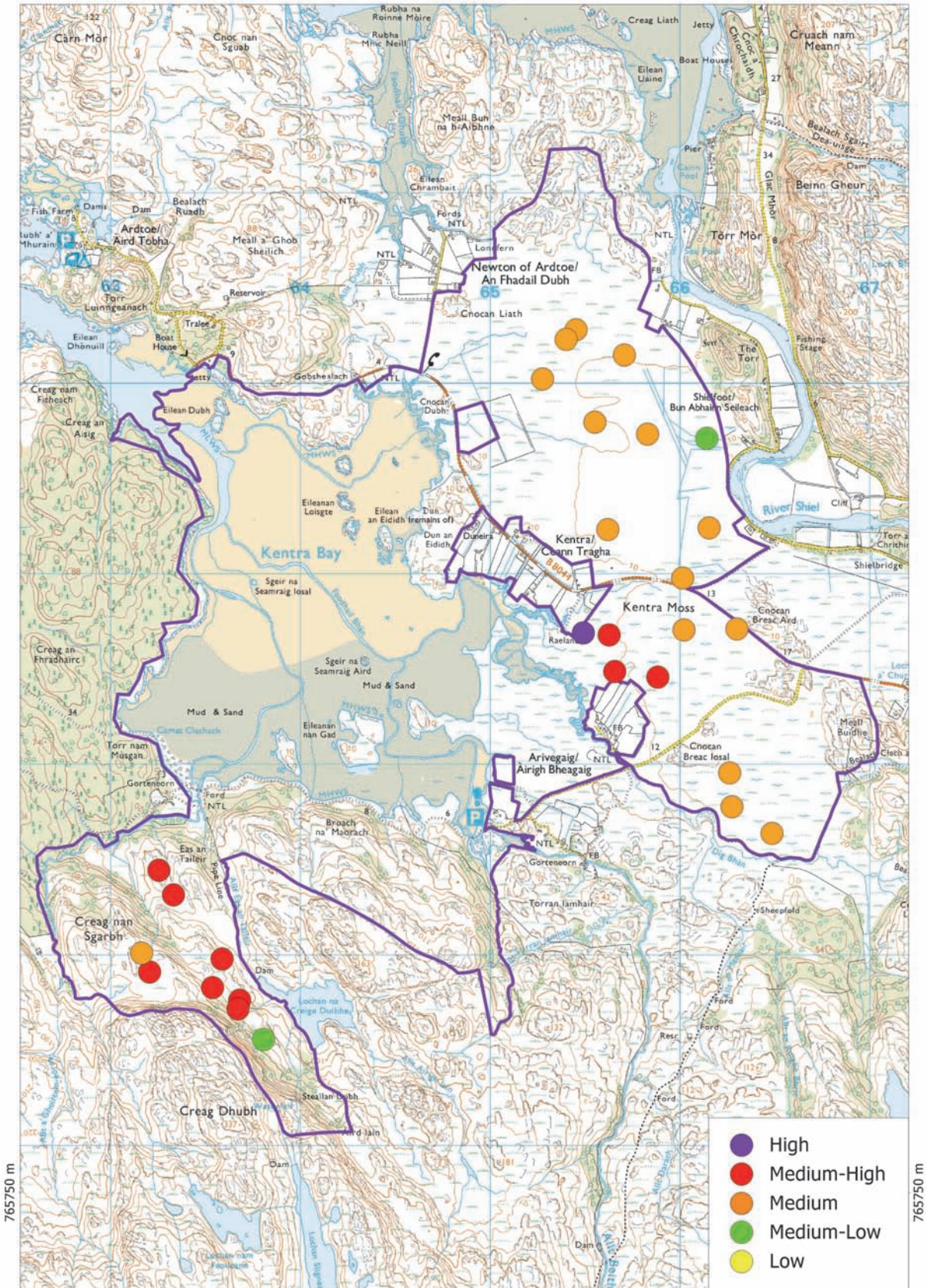


Figure 1. Grazing impacts at Kentra. © Crown copyright and database right 2018. Ordnance Survey 100017908).

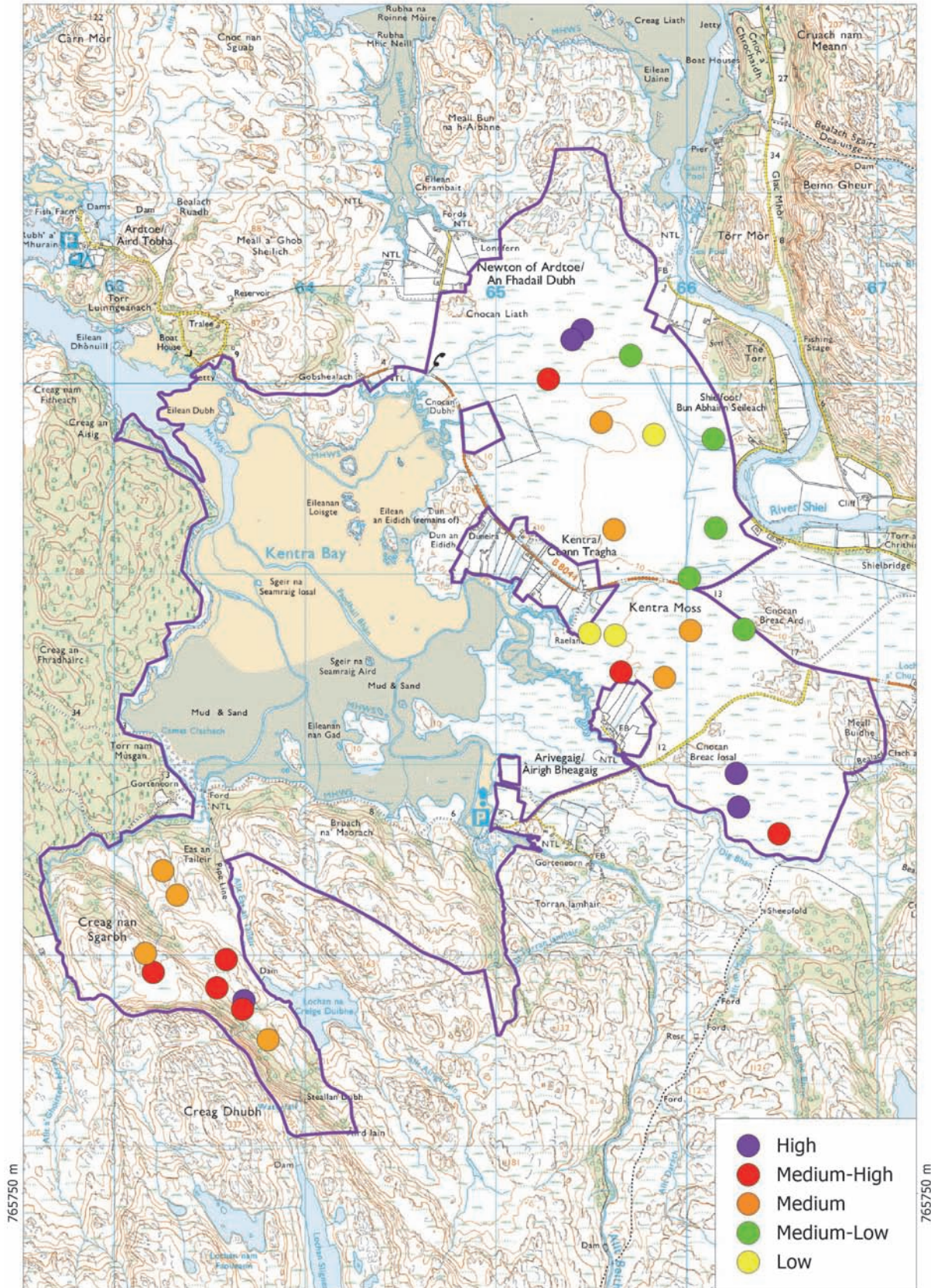


Figure 2. Trampling impacts at Kentra. © Crown copyright and database right 2018. Ordnance Survey 100017908).

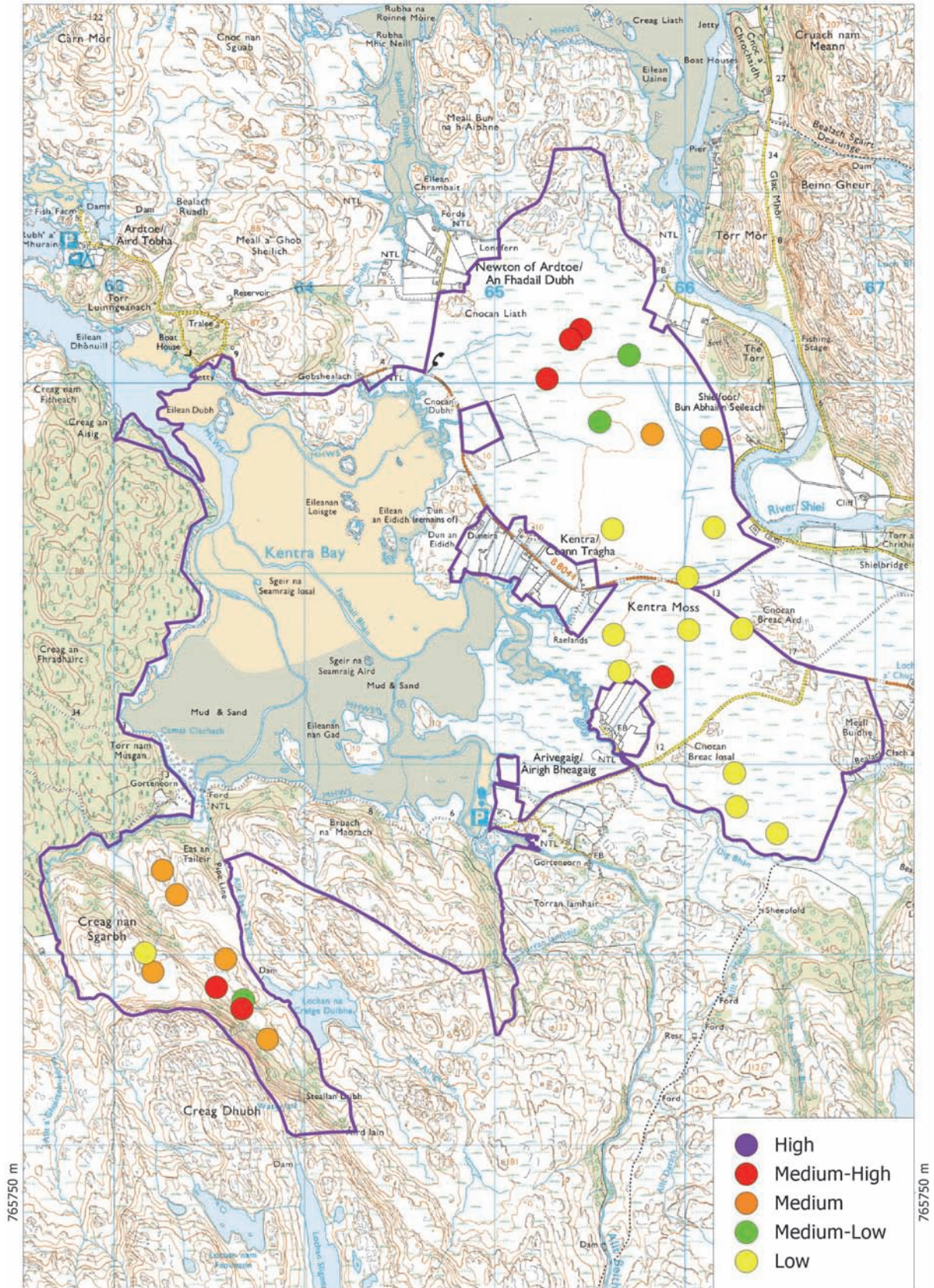


Figure 3. Dunging impacts at Kentra. © Crown copyright and database right 2018. Ordnance Survey 100017908).

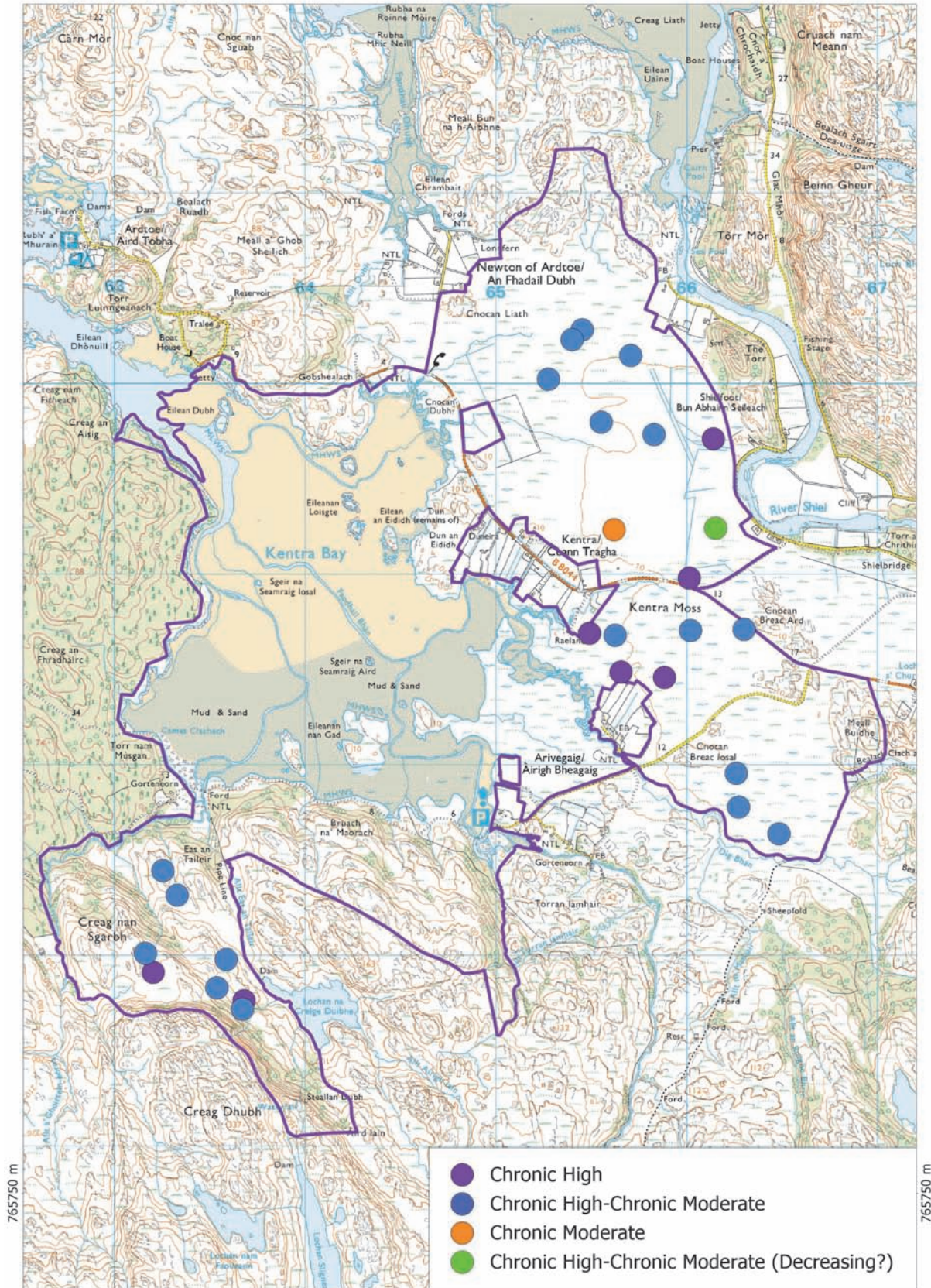


Figure 4. Grazing impact trends at Kentra. © Crown copyright and database right 2018. Ordnance Survey 100017908).

4. DISCUSSION

4.1 Herbivores

4.1.1 Kentra Moss

Herbivores access all areas of the bog, even the wettest areas, with tracks frequent throughout. There is locally frequent uprooting of/browsing of *Menyanthes trifoliata* in pools even in the wettest areas of the bog, and the *Sphagna* at pool edges in the wettest areas are disturbed.

Small groups of sheep were seen on all but the wettest areas of Kentra Moss, with the largest group (c. 30 sheep including lambs) seen on the bog around the Kentra township. No deer were seen grazing the bog but they might do so at dusk/dawn/at night (also see below). Cattle used to graze parts of the bog (at least around Arivegaig) but there were no signs of recent cattle grazing.

The main browsers in the wettest areas appear to be Red deer as most dung seen in these areas appeared to be Red deer dung. However, there were difficulties distinguishing between sheep and Red deer dung so the relative contribution of sheep and deer to the herbivore impacts is unclear. No dead sheep were found in the wettest areas (which would be expected given the sloppiness of the ground if sheep regularly used these areas) and a dead Red deer was found in one of the wettest areas. Sheep did appear to range widely over the bog and are probably a significant contributor to the observed herbivore impacts over much of the bog surface at Kentra Moss.

4.1.2 Kentra Bay

Sheep and deer graze throughout. Red deer were seen but roe may be present too.

4.2 Herbivore impacts

4.2.1 Kentra Moss

The heaviest grazing impacts are around Arivegaig where the bog has been subject to Chronic High grazing and is currently heavily grazed (Figures 1, 4). Some of the areas of bog are now supporting M15 *Scirpus-Erica* wet heath vegetation due to the past history of treatments including peat cutting, grazing and probably burning. The main areas of old peat cuttings are as expected along the road, by settlements at Arivegaig and Kentra. The far south of Kentra Moss also has degraded bog vegetation. In some areas the older peat cuttings are now flooded and have revegetated well with bog vegetation but above the flooded cutting the adjacent better drained areas of the bog surface often support degraded bog vegetation (e.g. M15).

Forty three percent of the sample points are subject to trampling impacts that are too high (18% High and 25% Medium-High) as the sheep/deer are trampling pool edges and disrupting *Sphagnum* mats. It is likely that the *Sphagnum* mats and pool edges in the areas seen will recover quite well with a reduction in trampling but how long this will take is unknown. Ongoing High and Medium-High trampling may lead to decline in the bog habitat, with continued disruption of bryophyte mats and pool edges. Moderately trampled and grazed blanket bog can have a high diversity of species but those species most characteristic of bogs such as *Sphagna* can decline (MacDonald *et al.* 1998).

Of most concern are the existing areas of patterned mire at Kentra Moss with Medium-High to High trampling. The areas of patterned mire are readily visible on aerial photographs. Those areas most threatened by trampling are the patterned areas just east of Cnocan Breac losal, and the patterned mire just east of Cnocan Liath. These areas generally have

frequent browsed/uprooted *Menyanthes* and the woody tissue of *Myrica* is browsed, but in most cases browsing itself is not the main issue, it is the associated trampling and disturbance to *Sphagnum* lawns and pool edges that is a cause for concern.

It is strongly recommended that trampling impacts are reduced and the trampling impacts should be subject to regular monitoring.

4.2.2 Kentra Bay

Kentra Bay has mostly small areas of degraded bog within a bog/wet heath mosaic, though a larger expanse of more intact bog immediately south of the top of Creag nan Sgarbh is of higher conservation interest and would benefit from lower grazing and trampling. Some of the smaller areas of degraded bog might benefit too, but others might become even more dominated by undesirable species such as *Molinia*.

4.3 Comparison with previous assessments

The peatland feature (*Rhynchosporion*) at Kentra Moss has been subject to Site Condition Monitoring (SCM). An assessment in 2006 (SNH, 2006) recorded that:

'The condition of this feature of interest was assessed as being 'favourable' in 2000'.

'The condition of the blanket bog interest feature of Kentra Bay and Moss SSSI [in 2006] is assessed as being 'unfavourable – declining' as the following targets were not met:

*Vegetation structure – indicators of browsing/ grazing (vegetation with Myrica);
Physical structure – indicators of ground disturbance due to herbivore and human activity, percentage cover of disturbed bare ground'.*

The following are extracts from the SCM for peatland features on Claish Moss and Kentra Moss SAC undertaken in 2014 (Wells, 2015):

'Kentra Moss, despite being mostly completely open around its borders, appeared to show very little evidence of trampling or grazing from deer'.

'The current survey is the first assessment that the sites have received since 2008 when it was found that they were both considered to be in favourable condition. Nevertheless concerns were raised regarding the open access nature of Kentra Moss component of the SAC which allowed grazing animals and activity such as turbary and fires to affect the conservation interest (SNH, 2008)'.

'Although such concerns still remain relevant, it appeared that the extant turbary is still small and affects a relatively small area on the fringes of the site. No signs of recent fires were noted and tracking and trampling effects appeared to be low. Most of the site appeared to be in excellent condition.'

The above conclusions of Wells (2015) are based on 10 plots at Kentra Moss (Figure 1). The targets for SCM differ from the thresholds for impact classes for the HIA. The SCM target for disturbance to sphagnum is that less than 10% of the *Sphagnum* should be 'crushed, broken or pulled up'. In fact the 2014 survey recorded that none of the *Sphagnum* in any of the plots was 'crushed, broken or pulled, so, the 2018 results appear to represent a genuine increase in *Sphagna* disturbance since 2014 (see below).

Looking at the 2018 data for Kentra Moss for damage to pool edges and *Sphagna* (Table 3) 32% of samples on the Moss have High or Medium-High trampling impacts to *Sphagnum* surfaces and 36% have High or Medium-High trampling impacts to pool edges at the 2x2 m plot scale (the impact to pool edges rising to 40.0% if we look at the 10x10m scale).

Table 3. The percentage of sample points showing each impact class (with the number of plots listed in brackets) for three of the Bog indicators. Note pools were present in 14 of the 2x2m plots and 15 of the 10x10m plots.

Indicators	Impact Class				
	High	Medium-High	Medium	Medium-Low	Low
Trampling/grazing of pool systems & water tracks(2x2m)	29 (4)	7 (1)	29 (4)	0	36 (5)
Trampling & grazing of pool systems & water tracks (10x10m dung plot area)	33 (5)	7 (1)	40 (6)	7 (1)	13 (2)
Trampling of <i>Sphagnum</i> hummocks & lawns in plot	21 (4)	11 (2)	16 (3)	0	53 (10)

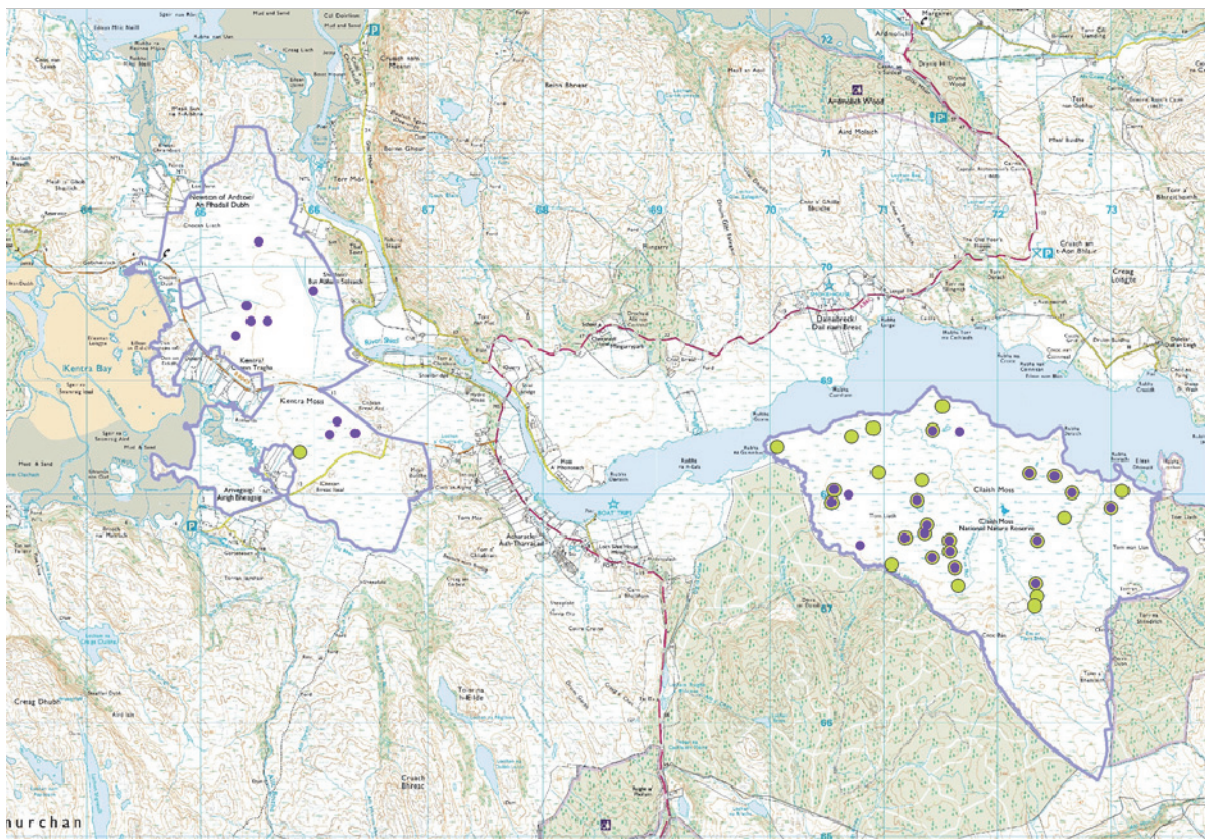


Figure 1. (Figure 1 from Wells, 2015). Clais & Kentra Moss SAC/SSSI showing site boundaries & distribution of sample locations for *Rhynchosporion* depression (purple) and blanket bog (green). (Maps reproduced under Ordnance Survey licence 100017908).

5. CONCLUSIONS

The main issues and concerns and recommendations are summarised below:

- There has been long term deterioration of the marginal areas of Kentra Moss due to past management (e.g. peat cutting, grazing, burning, and drainage), which is most obvious adjacent to roads, and adjacent tocrofting settlements. Modified bog vegetation is to be expected in these marginal areas, some of which are now M15 and no longer active bog, but old flooded peat cuttings are generally revegetating well and forming active bog. Old drains on the bog expanse are well vegetated but some water movement was observed. The drains that are most scoured are, as to be expected, along roadsides.
- The areas with damage include some of the more important, wetter areas of the bog at Kentra Moss which exhibit good patterning with abundant linear bog pools. Some of these areas supported *Sphagnum austinii* hummocks and Bog-sedge *Carex limosa* was locally frequent in some of the pools.
- The bog at Kentra Bay, heavily modified by a long history of grazing and burning, is generally less wet but there are some larger expanses of bog with more intact bog vegetation (*Scirpus-Eriophorum* mire, M17).
- Continued High and Medium-High herbivore impacts are likely to lead to a decline in the Bog habitat, primarily due to disruption of *Sphagna* and the trampling of edges of bog pools.
- The bog would benefit from reducing ongoing herbivore impacts, especially trampling impacts. Even moderate trampling can have negative impacts on bog features such as pools and *Sphagnum* lawns (MacDonald *et al.* 1998).
- At Kentra Moss the priority management should be to improve the condition of the bog.
- At Kentra Bay a wide range of SSSI features are found in addition to blanket bog, including woodland with important assemblages of lichen and bryophytes. The rich lichen assemblage is a grazing dependent feature and browsing levels that are too low could potentially have a negative impact on the lichen interest.

6. REFERENCES

MacDonald, A., Stevens, P., Armstrong, H., Immirzi, P. & Reynolds, P. 1998. *A Guide to Upland Habitats Surveying Land Management Impacts*. 2 Volumes. Scottish Natural Heritage, Battleby.

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ANNEX 1: DRAFT METHOD FROM THE SNH STATEMENT OF REQUIREMENTS

Herbivore Impact Assessment Method 2017 v0.1

Introduction

In order to fully understand the range of indicators used, their application and interpretation, successful contractors should be familiar with both volumes of A Guide to Upland Habitats: Surveying Land Management Impacts (MacDonald et al., 1998)¹, and the Addendum to this guide (MacDonald 2007)². The Guide first set out standardised methods for assessing herbivore impacts on upland habitats, and remains an essential reference, but some assessment, survey and reporting methods have developed over time in order to suit particular circumstances. This Annex sets out the methods to be used for this survey, and these are to be followed if they differ from the Guide. This is important for maintaining robustness, consistency and repeatability, and if there is any doubt, the contractor must discuss this with the Nominated Officer.

Features and habitat types

The document DRAFT Correspondence table for HIA v0.1 (Table 4) shows the relationships between notified features and habitat types to be used for HIA. The specific features to be assessed in a HIA survey, and the habitat assessment types to be used, will be set out in the relevant SoR.

Sample points

For extensive habitats, randomly-generated grid references for plot locations within each habitat type will be supplied. For some fragmentary habitats, vegetation mapping is insufficiently precise to allow generation of random points and sample points must be acquired opportunistically. This process should be aided by the use of information on known locations, and selecting areas of search based on knowledge of the environmental requirements of habitats. Repeat surveys will revisit sample points from earlier surveys where the same habitats were assessed (although these may sometimes need to be supplemented by new points). For repeat surveys previous plot photographs will usually be available from SNH to aid relocation.

At each sample point the vegetation type present is determined. It is particularly important that vegetation types are correctly identified so that the appropriate indicators are used. If the expected habitat is not present, it may be searched for within a 20m radius for extensive habitats (bog, heaths, grasslands), or a 50m radius for fragmentary habitats (flushes, tall herbs, scrub), and if the appropriate habitat is located, the sample point can be moved. The new 12-figure grid reference must be recorded in the results data.

Sample plots (Quadrats)

Grid references denote the SW corner of the plot, which is to be orientated N-S and E-W with the National Grid (i.e. magnetic bearings will be converted to Grid bearings).

Plot size is generally 4m² (2m x 2m) except for dung which is assessed at a 10m by 10m plot centred on the smaller plot. Plots on Flushes and some other fragmentary habitats may vary, for example 1m x 4m, depending on the shape and extent of the flush.

¹ MacDonald, A., Stevens, P., Armstrong, H., Immirzi, P. & Reynolds, P. 1998. A guide to upland habitats surveying land management impacts. Volumes 1 & 2. Scottish Natural Heritage, Battleby.

² MacDonald, A.J. 2007. Addendum to the guide to upland habitats: surveying land management impacts. Report to Scottish Natural Heritage Contract No. GS3399.

Assessment of Indicators

The appropriate small-scale grazing, trampling and dung indicators (DRAFT HIA Indicator tables 2017 v0.1 – see Annex 2) are recorded for each sample plot. The classes used are Low (L), Medium (M), and High (H), with intermediate classes (LM, MH) only used if necessary (see MacDonald 2007 section 11).

The appropriate trend indicators are recorded where possible, although sometimes they will not be applicable. Note that the trend indicator classes are not all mutually exclusive, e.g. a sample point can be recorded as both CH and D. In repeat assessments, direct comparison of results from current impact indicators in successive surveys will give more reliable indications of recent trends than the trend indicators which depend more on inference.

In addition to the recording of current impacts and trends, quantitative indicators are recorded. Many of these assess essentially the same indicators as those used in the impact assessment, but in a more quantitative and repeatable way. In a first assessment, these provide support for the assessment of current indicators, and in repeat assessments they will provide a useful means of monitoring habitat change.

Note is also taken of other relevant factors including the presence, or signs (e.g. dung, in cases where this is not already one of the prescribed indicators), of different species of herbivores (deer, sheep, cattle, hares, rabbits, voles, heather beetle, magpie moth etc.) and of other potential causes of impacts (humans, vehicles). Other factors which may assist in interpreting the impacts at the sample point, such as topography (exposed versus sheltered locations) or the existence of a through-route from one preferred habitat type to another, and recreational impacts are also noted.

Deriving impact classes for each plot

The results for individual small-scale field indicators for each plot are combined to produce impact classes for each plot. Overall impact classes (derived by combining results for all indicators) can mask important differences between grazing and trampling impacts, and therefore indicators are combined in groups to give separate assessments of grazing and trampling.

The impact class is derived from the median (middle value) of the scores for the indicators assessed. If there is an even number of indicators and the scores for the two middle values are different, the intermediate of the two middle values is taken. The process of deriving impact classes is to be shown clearly in the results spread sheets.

Some previous surveys have used other methods of combining indicator scores (primarily mean values calculated on the basis of applying numerical values to scores). For a comparison to be made with previous studies, it may be necessary to reanalyse previous survey data using the same method as used in the current survey.

Timing of survey

MacDonald (2007) sets out ideal and possible times for field assessment of different habitats (Figure 1 P28). While there may not be a single month in which assessment of all habitats in any individual survey is optimal, and there is year-to-year variation in weather and growth, the survey must be carried out at an acceptable time. The SoR will recommend a time period.

When field survey is not at the optimum time, the assessment of some attributes and targets may be less reliable. If this is the case, an explicit and unambiguous explanatory note should be made in both the field records and report.

Particular care is needed if assessing dwarf shrub habitats in summer, when the current year's growth will obscure the previous winter's off take.

Photographs

Digital photographs are taken of *each* impact assessment sample location to illustrate the impact categories and sample locations, i.e. one photograph of the plot and one context shot to assist relocation. Good quality digital images are required, of at least 6 megapixel resolution. Image quality should be sufficient to produce clear and detailed enlargements to A5 size. The filename for the photograph is recorded in the datasheets alongside the grid reference and impact data for each sample location along with the direction of shot by compass bearing.

Table 4. Correspondence Table for Herbivore Impact Assessment habitats, Feature types, and appropriate Guide to Upland Habitats survey habitats v.0.1 (from the SNH Statement of Requirements). Different classification systems are developed for different purposes, and therefore correspondences between them are not always exact. If you're unsure, ask. For further correspondences, including NVC and EUNIS, see <https://www.nature.scot/snh-commissioned-report-766-manual-terrestrial-eunis-habitats-scotland>

Dark shading = No appropriate standard HIA habitat

Light shading = Not commonly assessed

Annex 1 CODE	Annex 1 NAME	Annex 1 LAY TITLE	Equivalent SSSI feature type (*= incomplete correspondence - may be broader/narrower than the Annex 1 type)	Upland CSM feature type	Short form for use in report text	Guide to Upland Habitats - Habitat type 1	Guide to Upland Habitats - Habitat type 2	Note
H7230	Alkaline fens	Calcium-rich spring water fed fens.	1) Alkaline fen 2) Subalpine flushes*	Alkaline fen	Alkaline fen	Flush		
H4060	Alpine and Boreal heaths	Alpine and subalpine heaths.	Alpine heath	Alpine dwarf-shrub heath	Alpine heath	Wind-clipped Summit Heath		Sometimes known as Montane heath
H6170	Alpine and subalpine calcareous grasslands	Alpine calcareous grasslands.	1) Alpine calcareous grassland 2) Dryas heath*	Calcareous grassland	1) Alpine calcareous grassland 2) Dryas heath	Smooth Grassland		
H7240	Alpine pioneer formations of <i>Caricion bicoloris-atrofuscae</i>	High altitude plant communities associated with areas of water seepage.	Alpine flush	Alpine flush	Alpine flush	Flush		
H7130	Blanket bogs	Blanket bogs.	1) Blanket bog 2) Intermediate bog (blanket)* 3) Saddle mire*	Blanket bog and valley bog	Blanket bog	Bog		

H6130	Calaminarian grasslands of the <i>Violetalia calaminariae</i>	Grasslands on soils rich in heavy metals.	Calaminarian grassland and serpentine heath*	Calaminarian grassland and serpentine heath	1) Calaminarian grassland 2) Serpentine heath	Smooth Grassland		
H8120	Calcareous and calcshist screes of the montane to alpine levels (<i>Thlaspietea rotundifolii</i>)	Base-rich scree.	1) Calcareous scree 2) Montane fell-field*	Calcareous scree	1) Base-rich scree 2) Fell-field	N/A		
H8210	Calcareous rocky slopes with chasmophytic vegetation	Plants in crevices in base-rich rocks.	Rocky slopes (includes inland cliff, rocky outcrops, chasmophytic vegetation)*	Calcareous rocky slope	Calcareous rocky slope	N/A		
H7150	Depressions on peat substrates of the <i>Rhynchosporion</i>	Depressions on peat substrates.	Blanket bog*	Blanket bog and valley bog	Rhynchosporion depressions	Bog		
H4030	European dry heaths	Dry heaths.	Subalpine dry heath	Subalpine dwarf-shrub heath	Dry heath	Dwarf-shrub heath		
H6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	Tall herb communities.	Tall herb ledge*	Tall herbs	Tall herbs	Tall herbs		Annex 1 type includes only NVC U17, SSSI type includes both U16 and U17
H5130	<i>Juniperus communis</i> formations on heaths or calcareous grasslands	Juniper on heaths or calcareous grasslands.	1) Moorland juniper* 2) Juniper scrub*	Juniper heath and scrub	Juniper	Scrub		
H8240	Limestone pavements	Limestone pavements.	Limestone pavement	Limestone pavement	Limestone pavement	N/A		

H4010	Northern Atlantic wet heaths with <i>Erica tetralix</i>	Wet heathland with cross-leaved heath.	Subalpine wet heath	Wet heath	Wet heath	Dwarf-shrub heath	Bog	Either GUH type may be appropriate depending on the nature of the wet heath present.
H7220	Petrifying springs with tufa formation (Cratoneurion)	Hard water springs depositing lime.	Spring-head, rill and flush*	Spring-head, rill and flush	Petrifying springs	Flush		
H6210	Semi-natural dry grasslands and scrubland facies: on calcareous substrates (Festuco-Brometalia)	Dry grasslands and scrublands on limestone.	Subalpine calcareous grassland*	Calcareous grassland	Dry grasslands	Smooth grassland		
H6150	Siliceous alpine and boreal grasslands	Montane acid grasslands.	1) Alpine moss heath and associated vegetation 2) Snowbed*	Alpine summit communities of moss, sedge and three-leaved rush	1) Montane acid grassland 2) Snowbed	Wind-clipped Summit Heath	Custom indicator set (Addendum 5.2.3)	Use WCSH for NVC U8,U9,U10, Custom set for NVC U7,U13
H8220	Siliceous rocky slopes with chasmophytic vegetation	Plants in crevices on mainly acid rocks.	Rocky slopes (includes inland cliff, rocky outcrops, chasmophytic vegetation)*	Siliceous rocky slope	Acidic rocky slope	N/A		
H8110	Siliceous scree of the montane to snow levels (Androsacetalia alpinae and Galeopsietalia ladani)	Acidic scree.	1) Siliceous scree (includes boulder fields) 2) Montane fell-field*	Siliceous scree	Acidic scree	N/A		

H6230	Species-rich Nardus grassland, on siliceous substrates in mountain areas (and submountain areas in continental Europe)	Species-rich Nardus grassland, on acid soils in upland areas.	Subalpine calcareous grassland*	Calcareous grassland	Species-rich Nardus	Smooth Grassland		
H4080	Sub-Arctic Salix spp. scrub	Mountain willow scrub.	N/A	Montane willow scrub	Montane willow scrub	Scrub		
H7140	Transition mires and quaking bogs	Very wet mires often identified by an unstable 'quaking' surface.	Blanket bog*	Transition mire, ladder fen and quaking bog	Transition mire	Bog		
N/A	N/A	N/A	Subalpine acid grassland	None	Acid grassland	Smooth Grassland	Tussock Grassland	Use SG for NVC U4, TG for U5
N/A	N/A	N/A	Spring-head, rill and flush	Spring-head, rill and flush	Flush	Flush		

ANNEX 2: DRAFT INDICATOR TABLES FROM THE SNH STATEMENT OF REQUIREMENTS

Table 5. DRAFT HIA Indicator tables 2017 v0.1. These tables give details of Indicators for use in Herbivore Impact Assessment in different habitat types. They are associated with DRAFT Herbivore Impact Assessment Method 2017 v0.1 (Annex 1).

Habitat category for assessment in MacDonald et al. (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald et al. 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
Smooth grassland	Acid grassland (part) Alpine calcareous grassland Calaminarian grassland Dry grasslands Dryas heath Species-rich Nardus	Current browsing, grazing and trampling impacts	• Sward height and texture	G	Record the average sward height from 10 measures within the plot.
			• Uprooted bundles of grass tillers	G	
			• Accumulation of dead plant litter in the sward	G	
			• Signs of grazing on <i>Alchemilla alpina</i> , <i>Juncus squarrosus</i> , <i>Nardus stricta</i> , <i>Prunella vulgaris</i> , <i>Sibbaldia procumbens</i> , or <i>Thymus polytrichus</i>	G	Record %age of leaves grazed.
			• Signs of grazing (collectively) on legume species (e.g. <i>Lotus corniculatus</i> , <i>Lathyrus linifolius</i> <i>Trifolium repens</i>) or <i>Plantago lanceolata</i>	G	Record percentage of leaves grazed.
			• Signs of grazing on <i>Dryas octopetala</i>	G	
			• Flowering of grasses and forbs other than very small, creeping or cushion forming species, in which the flowers are carried at heights of <3cm, or less palatable species.	G	
			• Signs of grazing on leaves (collectively) <i>Agrostis capillaris</i> , <i>Anthoxanthum odoratum</i> , <i>Danthonia decumbens</i> , <i>Deschampsia flexuosa</i> , <i>Festuca rubra</i> , <i>Holcus sp</i> , <i>Poa sp</i> , and sedges.	G	Record %age of leaves grazed, based on an average assessment from 10 “handfuls” (circles of approximately 5cm diameter) spread throughout the sample plot.
			• Signs of grazing on leaves of (collectively) <i>Agrostis canina</i> , <i>Festuca ovina</i> and <i>F. vivipara</i> .	G	Record percentage of leaves grazed.
• Signs of grazing on leaves of <i>Deschampsia cespitosa</i>	G	Record percentage of leaves grazed.			

Habitat category for assessment in MacDonald et al. (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald et al. 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
			<ul style="list-style-type: none"> Cover of mosses, particularly “feather” mosses such as <i>Rhytidiadelphus squarrosus</i>, <i>Pleurozium scheberi</i>, <i>Pseudoscleropodium purum</i>, <i>Hypnum cupressiforme</i> and <i>Hylocomium splendens</i>. 	T	
			<ul style="list-style-type: none"> Seedlings and saplings of trees and shrubs 	G	
			<ul style="list-style-type: none"> Breakage and uprooting of shoots of <i>Silene acaulis</i>, <i>Minuartia sedoides</i>, <i>Huperzia selago</i>, <i>Saxifraga hypnoides</i>, <i>Selaginella selaginoides</i>. 	T	
			<ul style="list-style-type: none"> Density of shoots of cushion-forming plants, e.g. <i>Silene acaulis</i> and <i>Minuartia sedoides</i> and occurrence of “weeding” of grasses from the cushions by grazing animals 	G	
			<ul style="list-style-type: none"> Amount of bare ground 	T	Record what percentage of the plot has been disturbed by hoofprints.
			<ul style="list-style-type: none"> Amount of dung of grazing animals (sheep and deer dung pellet groups) 	D	
		Impact trends	<ul style="list-style-type: none"> Grazing indicated by sward height versus grazing impact deduced from signs of grazing on plants 	G	
			<ul style="list-style-type: none"> Degree of flowering and vegetative state of potentially taller herbs 	G	
			<ul style="list-style-type: none"> Cover and frequency of small rosette-forming creeping or mat-forming herbs or dwarfed plants of taller growing species 	G	
			<ul style="list-style-type: none"> Presence of “weedy” species such as <i>Cirsium arvense</i>, <i>Juncus effusus</i>, <i>Senecio jacobaea</i> or <i>Stellaria media</i> in dense, extensive patches. 	G	
			<ul style="list-style-type: none"> Presence of trees and shrub species 	G	
		Herbivore species present	<ul style="list-style-type: none"> Record which herbivore species are present and whether impacts are clearly attributable to one or more species. 		

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
Flush	Alkaline fen Alpine flush Flush Petrifying springs	Current grazing and trampling impacts	<ul style="list-style-type: none"> Percentage of surface "poached" with hoof-prints 	T	Record what % of the plot has been disturbed by hoofprints.
			<ul style="list-style-type: none"> Disruption of moss and liverwort carpet around spring-heads and edges of rills 	T	
			<ul style="list-style-type: none"> Amount of pulled-up mosses and other plants 	G	
			<ul style="list-style-type: none"> Height of vegetation 	G	Record the average height of vegetation from 10 measures within the plot.
			<ul style="list-style-type: none"> Percentage of leaves of sedges and grasses which collectively show signs of having been grazed 	G	Record %age of leaves of sedges and grasses grazed.
			<ul style="list-style-type: none"> Extent to which flowering heads of <i>Carex</i> spp. are bitten off 	G	
			<ul style="list-style-type: none"> Signs of grazing on <i>Juncus effusus</i>, <i>Equisetum</i> spp., or <i>Erica tetralix</i>. 	G	
			<ul style="list-style-type: none"> Amount of grazing of leaves and shoots, and amount of flowering, of <i>Cardamine pratensis</i> and <i>C. flexuosa</i> 	G	
			<ul style="list-style-type: none"> Vigour and degree of flowering of tall herbs <i>Crepis paludosa</i>, <i>Filipendula ulmaria</i>, <i>Succisa pratensis</i>, and <i>Valeriana officinalis</i> 	G	
		<ul style="list-style-type: none"> Flowering of <i>Armeria maritima</i> 	G		
Grazing impact trends		<ul style="list-style-type: none"> Frequency or abundance of rushes or "grassland" species such as <i>Agrostis canina</i>, <i>A. capillaris</i>, <i>A. stolonifera</i>, <i>Anthoxanthum odoratum</i>, <i>Deschampsia cespitosa</i>, <i>Galium saxatile</i>, <i>Holcus lanatus</i>, <i>Juncus squarrosus</i>, <i>Molinia caerulea</i>, <i>Nardus stricta</i>, and <i>Potentilla erecta</i>; or of <i>Juncus effusus</i> or <i>J. acutiflorus</i>; or of <i>Polytrichum commune</i> 	G		
		<ul style="list-style-type: none"> Height of any bushes of <i>Myrica gale</i> and <i>Salix</i> spp. 	G		

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
Blanket bog	<i>Blanket Bog</i> <i>Wet heath (part)</i>	Current trampling and grazing impacts	Trampling and grazing of pool systems and water tracks	T	
			<ul style="list-style-type: none"> Trampling of <i>Sphagnum</i> moss hummocks and lawns 	T	Record the % of the plot covered by intact <i>Sphagnum</i> spp.
			<ul style="list-style-type: none"> Extent of ground cover by bryophytes and/or lichens among and between dwarf-shrub, sedge and grass plants 	T	
			<ul style="list-style-type: none"> Abundance of hoof prints in bare peat over the assessment unit 	T	Record what % of the plot has been disturbed by hoofprints. Record the % of the plot covered by bare peat. Record the % or the plot covered by re-vegetating bare peat, e.g. with established <i>E. vaginatum</i> .
			<ul style="list-style-type: none"> Firmness of ground underfoot 	T	
			<ul style="list-style-type: none"> Browsing of <i>Betula nana</i> 	G	
			<ul style="list-style-type: none"> Signs of browsing on <i>Arctostaphylos uva-ursi</i>, <i>Empetrum nigrum</i>, <i>Erica tetralix</i> or <i>Vaccinium vitis-idaea</i> 	G	
			<ul style="list-style-type: none"> Amount of flower or fruit on <i>Rubus chamaemorus</i> 	G	
			<ul style="list-style-type: none"> Amount of flowering of <i>Eriophorum</i> spp. 	G	
<ul style="list-style-type: none"> Growth-form and evidence of browsed shoots on <i>Myrica gale</i> bushes 	G				

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
			Conspicuousness of browsing on <i>Calluna vulgaris</i> or <i>Vaccinium myrtillus</i>	G	Record the % of long-shoots of <i>Calluna</i> and/or <i>Vaccinium</i> browsed. Record % for each species separately, based on an average assessment from 10 handfuls (circles of approximately 5cm diameter) of shoots. Record the average height of dwarf shrub cover from 10 measures within the plot.
			Amount of herbivore dung present	D	
		Grazing and trampling - impact trends	Changes in growth form recorded within the structure of dwarf-shrub bushes	G	
			Height of <i>Myrica gale</i>	G	
			Height and cover of dwarf shrubs relative to graminoids	G	
			Abundance of <i>Juncus squarrosus</i> and its growth relative to other vegetation components	G	
			Presence of species more typical of drier grassland such as <i>Agrostis canina</i> , <i>A. capillaris</i> , <i>Anthoxanthum odoratum</i> , <i>Deschampsia flexuosa</i> , <i>Festuca ovina</i> and <i>Nardus stricta</i>	G	
			<i>Carex panicea</i> abundant on drier "ridge" elements of bog patterning	T	
		Herbivore species present	Record which herbivore species are present and whether impacts are clearly attributable to one or more species.		

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
Dwarf shrub heath	<i>Dry heath</i> <i>Wet heath (part)</i>	Current browsing impact	<ul style="list-style-type: none"> Signs of browsing on <i>Arctostaphylos uva-ursi</i>, <i>Empetrum nigrum</i>, <i>Erica tetralix</i> or <i>Vaccinium vitis-idaea</i> (or associated <i>Nardus stricta</i>) 	G	
			<ul style="list-style-type: none"> Average proportion of long-shoots of <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> showing signs of having been browsed 	G	<p>Record the % of long-shoots of <i>Calluna</i> and/or <i>Vaccinium</i> browsed. Record % for each species separately, based on an average assessment from 10 handfuls (circles of approximately 5cm diameter) of shoots.</p> <p>Record the average height of dwarf shrub cover, from 10 measures within the plot.</p>
			<ul style="list-style-type: none"> Amount of flower or fruit on <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> 	G	
			<ul style="list-style-type: none"> Summer browsing of <i>Calluna vulgaris</i> 	G	
			<ul style="list-style-type: none"> Type of shoot material removed from <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> 	G	
			<ul style="list-style-type: none"> Growth-form and evidence of browsed shoots on <i>Myrica gale</i> bushes 	G	
			<ul style="list-style-type: none"> Uprooting of dwarf-shrub seedlings in recently burnt patches 	G	
			<ul style="list-style-type: none"> Stem breakage as a result of trampling by larger herbivores (check for hoof prints) 	G presumably T	
			<ul style="list-style-type: none"> Depth of carpet mosses and liverworts or "bushy" <i>Cladonia</i> lichens, under and between the dwarf-shrubs 	T	
<ul style="list-style-type: none"> Amount of trampled, bare ground 	T				

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
			<ul style="list-style-type: none"> Amount of herbivore dung present 	D	
		Grazing impact trends	<ul style="list-style-type: none"> Growth-forms of <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> 	G	
			<ul style="list-style-type: none"> Changes in growth form recorded within the structure of dwarf-shrub bushes 	G	
			<ul style="list-style-type: none"> Presence of “drumstick”, “topiary” and “carpet” growth forms 	G	
			<ul style="list-style-type: none"> Height and cover of dwarf-shrubs relative to graminoids 	G	
		Herbivore species present	<ul style="list-style-type: none"> Record which herbivore species are present and whether impacts are clearly attributable to one or more species. 		

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
Tussock grassland	<i>Acid grassland (part)</i>	Current grazing and trampling impacts	<ul style="list-style-type: none"> Signs of grazing on <i>Nardus stricta</i> tussocks, where sheep or red deer are the principal grazing animals. 	G	
			<ul style="list-style-type: none"> Signs of grazing on <i>Nardus stricta</i> tussocks, where cattle are the principal grazing animals 	G	
			<ul style="list-style-type: none"> Average inter-tussock sward height. 	G	Record the average inter-tussock sward height from 10 measures within the plot.
			<ul style="list-style-type: none"> Accumulation of dead plant litter. 	G	
			<ul style="list-style-type: none"> Signs of grazing of less palatable species (other than tussock-formers) such as <i>Juncus</i> spp., <i>Cirsium</i> spp. <i>Galium saxatile</i>, <i>Potentilla erecta</i>, mosses. 	G	Record %age of leaves grazed.
			<ul style="list-style-type: none"> Flowering of associated herbs in inter-tussock vegetation (June - August). 	G	
			<ul style="list-style-type: none"> Signs of grazing on leaves of (collectively) <i>Agrostis capillaris</i>, <i>Anthoxanthum odoratum</i>, <i>Danthonia decumbens</i>, <i>Deschampsia flexuosa</i>, <i>Festuca rubra</i>, <i>Holcus</i> spp., <i>Poa</i> spp. and sedges. 	G	Record %age of leaves grazed, based on an average assessment from 10 "handfuls" (circles of approximately 5cm diameter) spread throughout the sample plot.
			<ul style="list-style-type: none"> Signs of grazing on leaves of (collectively) <i>Agrostis canina</i>, <i>Festuca ovina</i>, and <i>F. vivipara</i>. 	G	
			<ul style="list-style-type: none"> Signs of grazing on the leaves of <i>Deschampsia cespitosa</i> 	G	
		Grazing impact trends	<ul style="list-style-type: none"> Seedlings and saplings of trees and shrubs > 5 cm tall. 	G	
<ul style="list-style-type: none"> Amount of bare ground. 	T				
		<ul style="list-style-type: none"> Cover of mosses, particularly <i>Polytrichum commune</i> and "feather" mosses such as <i>Pleurozium schreberi</i> and <i>Hylocomium splendens</i>. 	T		
		<ul style="list-style-type: none"> Grazing impact indicated by inter-tussock sward height relative to grazing impact deduced from signs of grazing on plants. 	G		

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used (short form)	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/ frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding quantitative measures
			<ul style="list-style-type: none"> Degree of flowering and vegetative state of potentially taller herbs e.g. <i>Succisa pratensis</i> (see also Tall herbs). 	G	
			<ul style="list-style-type: none"> Abundance and relative growth of <i>Juncus squarrosus</i> and other small, rosette-forming, creeping or mat-forming herbs (e.g. <i>Galium saxatile</i>, <i>Polygala serpyllifolia</i>, <i>Potentilla erecta</i>, <i>Viola palustris</i>), or dwarfed plants of taller growing species, in the inter-tussock vegetation. 	G	
			<ul style="list-style-type: none"> Cover of mosses, particularly <i>Polytrichum commune</i> and "feather" mosses such as <i>Pleurozium schreberi</i> and <i>Hylocomium splendens</i> versus what is deduced from other indicators. 	G	
			<ul style="list-style-type: none"> Presence of tree and shrub saplings versus sward height. 	G	
		Herbivore species present	<ul style="list-style-type: none"> Record which herbivore species are present and whether impacts are clearly attributable to one or more species. 		

ANNEX 3: DATA

This annex can be downloaded from the SNH website as a separate document.

ANNEX 4: PHOTOGRAPHS

This annex can be provided on request.

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