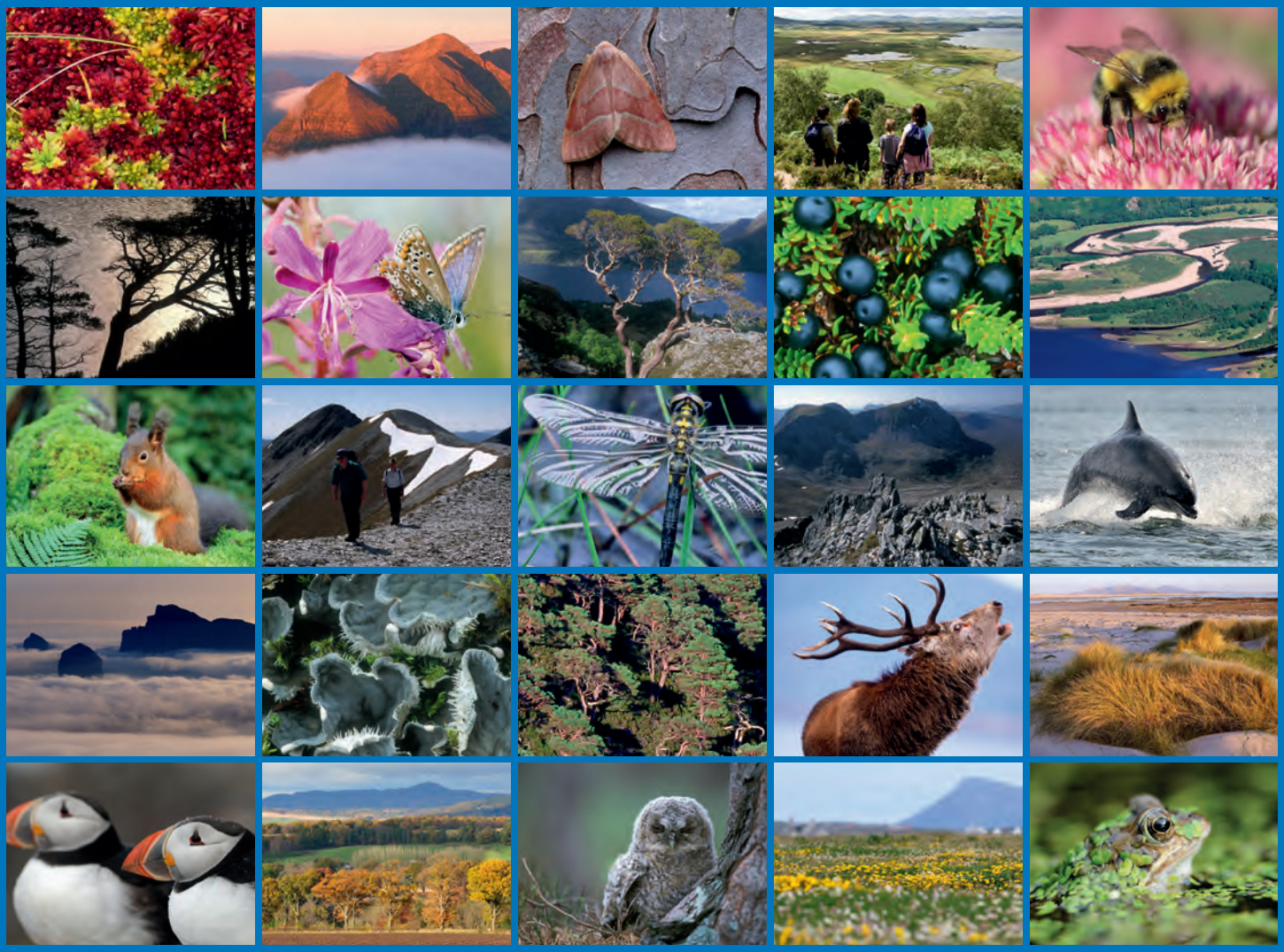
Scottish Natural Heritage
Research Report No. 1184

Assessment of herbivore impacts at Ben Hiant, Sunart SSSI



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RESEARCH REPORT

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Assessment of herbivore impacts at Ben Hiant, Sunart SSSI

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RESEARCH REPORT

Summary

Assessment of herbivore impacts at Ben Hiant, Sunart SSSI

Research Report No. 1184
Project No: 117136
Contractor: Andy Acton
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Keywords

Sunart SAC; wet heath; dry heath; upland assemblage; Lochaber; Ardnamurchan DMG.

Background

A herbivore impact assessment (HIA) of the upland assemblage feature of Ben Hiant within Sunart SSSI and SAC was undertaken in 2018. The habitats assessed were Blanket bog, Wet heath, Dry heath, Flush, Acid grassland and Species-rich *Nardus* grassland.

Main findings

- Herbivore impacts were assessed at 160 plots, with plots in Blanket bog, Wet heath, Dry heath, Acid grassland and Species-rich *Nardus* grassland.
- Seventy three percent of all plot had Chronic High grazing with 36% currently subject to High grazing impacts, 17% High trampling impacts and 47% High dunging impacts.
- Ninety six percent of Bog plots have been subject to Chronic Heavy grazing with 82% currently subject to Medium-High grazing, 39% to High trampling and 54% to High dunging impacts.
- All plots in heaths have been subject to Chronic Heavy grazing. All Dry heath plots and 72% of Wet heath plots are currently subject to High grazing impacts.
- Seventy three percent of Flush plots have been subject to Chronic Heavy grazing with 50% currently subject to Medium-High grazing, and 39% to Medium-High trampling.
- More than 80% of the grassland plots have been subject to Chronic Heavy grazing. Less than 20% of grassland plots are currently subject to high grazing impacts.
- The main concerns are the ongoing loss of Dry heath at the site due to heavy browsing, and the trampling on the Bog which is disturbing *Sphagnum* lawns and pools.
- A potential concern will be any increase in bracken if grazing/trampling is reduced. An 'Action Plan' should be in place to monitor/control bracken before it becomes a problem.

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Acknowledgements

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1. INTRODUCTION

1.1 Background

Sunart SSSI is notified for a range of habitats including the following which all occur at Ben Hiant: Upland assemblage, Upland oakwood, Lichen assemblage and Bryophyte assemblage (SNH, 2010) The Upland assemblage comprises the following component habitats: acid grassland, blanket bog, calcareous grassland, spring-heads, rills and flushes, subalpine dry dwarf-shrub heath and wet heath. These upland habitats were surveyed as part of this contract. Sunart SAC features are Western acidic oakwood, Dry heaths and Wet heath with cross-leaved heath. The last round of Site Condition Monitoring (SCM) of upland and peatland notified features on Sunart SSSI/SAC (Wells, 2015) found that:

> *All assessed components failed.*
>
> *A major reason for failure of heath points was invasive bracken*
>
> *In the western part of the site [which includes Ben Hiant] high grazing by sheep also caused failures.*
>
> *Sheep stocking levels were high at the western end of the site … especially around Ben Hiant where intensive grazing and trampling had led to significant impacts on grasslands, heathlands and flushes.*

The purpose of this survey is to obtain information that will allow *SNH and land managers to monitor progress towards condition objectives at the Sunart SSSI and SAC.*

The objectives of the work were to:

- Assess current grazing and trampling impacts from herbivores on Blanket bog, Wet heath, Dry heath, Flush, Species-rich *Nardus* grassland and Acid grassland, and the direction of any apparent trends in impact levels;
- Capture images of the sample plots using fixed point digital photography; and
- Provide prognoses for habitat condition based on current levels of impact.

2. METHODS

2.1 Plot selection

SNH provided 8 plot locations for flush vegetation and surveyors were to visit these and attempt to complete additional plots opportunistically. For all other habitats potential plot locations were generated randomly by SNH using vegetation maps. Vegetation maps often include polygons with more than one vegetation type, so generation of random sample plots using GIS may result in habitat types forecast at potential plot locations being different from those found on the ground (within 20 m 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 plots were to be surveyed in each habitat, so SNH provided 37 potential plot locations for each (apart from the flush habitat), in order to allow for potential plot locations discarded during survey. The potential plot locations are shown in Figure 1.

The grid reference for the plot is given on the recording spreadsheet (Annex 4). 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 was generally 4m^2 (2m x 2m) except for dung which was assessed in 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.

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.

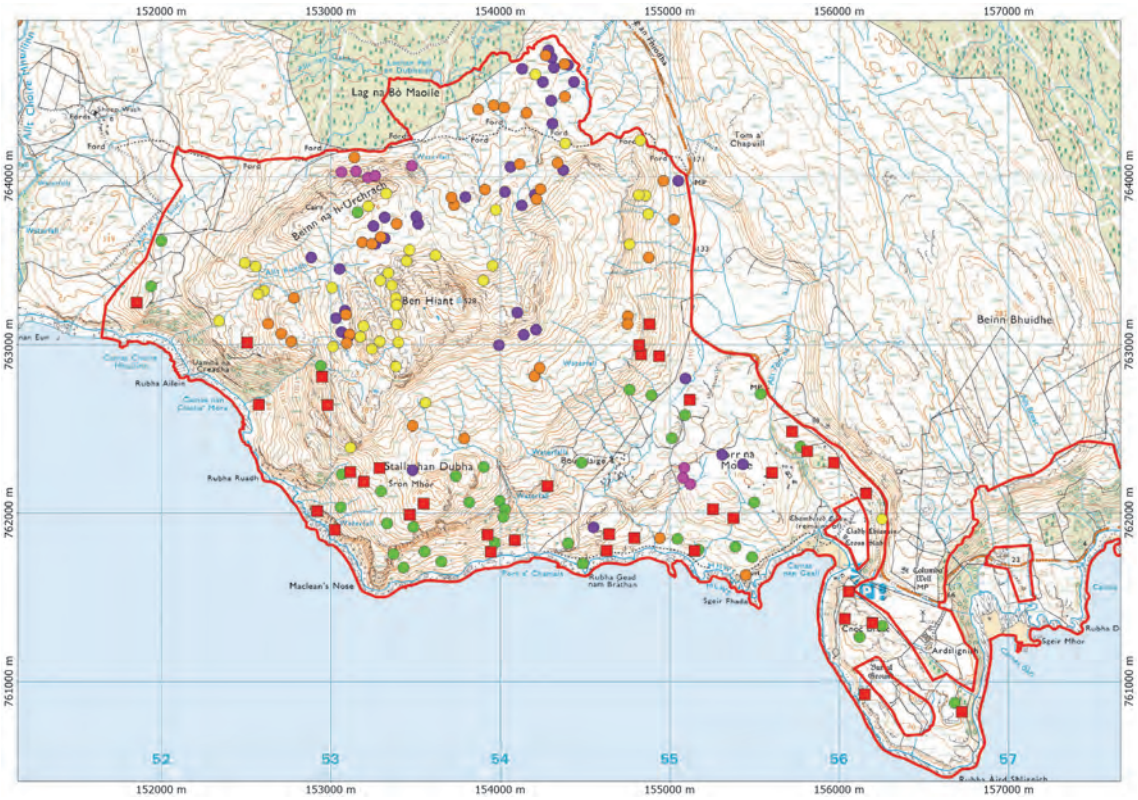

Figure 1. The survey site showing the candidate plot locations provided by SNH. © Crown copyright and database right 2018. Ordnance Survey 100017908.

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 habitats. A number of quantitative indicators were also assessed.

Full details of the HIA methods used are presented in Annex I. The appropriate small-scale grazing, trampling and dung indicators (see 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). In some of the plots the indicators were judged to be uninformative (U) and in others the indicators were not applicable (NA).

A number of quantitative indicators, were also assessed (see Annex I).

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

- The coastal strip in the vicinity of Uamha na Creadha (between Rubha Ruadh and Rubha Ailein) was excluded from the survey area due to nesting Schedule 1 birds. This meant that a number of sample points could not be visited, but did not result in a reduction in sample size for any habitat.

- Often the 2x2 m plots in bog and wet heath did not pick up any appreciable trampling impact despite frequent animal tracks in the 10x10m plot. Tracks were assessed in the 10x10 m dung plot as well as in the 2x2 m plot.

- MacDonald *et al.* (1998) acknowledge that sometimes indicators do not always distinguish between all classes of impact. This was most commonly the case for the Chronic High-Chronic Moderate trend indicators, but also occasionally distinguishing between High and Medium impacts. Chronic High-Chronic Moderate should be interpreted to indicate that the trend could not be allocated with confidence to either Chronic Moderate or Chronic Heavy, rather than interpreted that the trend was somewhere in between Chronic Moderate to Chronic Heavy. HM most usually indicates a level of impact intermediate between High and Medium, but for some of the indicators it indicates High or Medium. The method should be refined to more clearly distinguish the two.

- No trampling trends were discernible from the data collected. These would be best assessed through regular repeat monitoring.

- In many other cases it was very difficult to assess trends in grazing based on the trend indicators. Although greater confidence can generally be placed in current indicators than trend indicators, often at least one of the trend indicators was useful in cases of Chronic Heavy browsing, and in this situation the Trend indicators could usually be assigned with confidence. But in other instances the allocation to trend class was often tentative (and indicated by a question mark). Trend *direction* data was generally not allocated as it could not be allocated with a high degree of confidence. Long term data from repeat monitoring would be the most reliable way to assess trends and the trend directions.

- MacDonald *et al.* (1998) use cover of feather mosses in Acid Grassland used as an indicator of current trampling but in the author's view the cover of moss is best considered as a result of high herbivore impacts in the recent past and/or historical impacts.

- It was often difficult to distinguish between sheep and Red deer dung so the relative contribution of these grazers to the herbivore impacts was sometimes difficult to determine.

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

3. RESULTS

The spreadsheets showing the full results (including the results for the quantitative indicators) are included in Annex 4. A summary of the results for the impact assessment across the study site is presented in section 3.1. The summary results for the individual habitats (including the results of the assessment of quantitative indicators) are presented in sections 3.2-3.7.

3.1 Impacts across the site

Herbivore impacts were assessed at 160 plots in a range of habitats: Blanket bog (28 plots), Wet heath (29 plots), Dry Heath (29 plots), Flush (18 plots), Acid grassland (28 plots) and Species-rich *Nardus* grassland (28 plots). Thirty-six per cent of samples (58 plots) had High grazing impacts, 17% (27 plots) High trampling impacts and 47% (75 plots) had High dunging impacts (Table 1). The results are summarised in Table 1 and presented as Pie charts in Figures 2-4.

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

	Impact Class						
Indicators	High	Medium-High	Medium	Medium-Low	Low	Uninform-ative	Not applicable
Grazing	**36** (58)	**35** (56)	**24** (22)	**11** (18)	**4** (6)	0	0
Trampling	**17** (27)	**21** (34)	**40** (64)	**20** (32)	**1** (1)	**1** (2)	0
Dunging	**47** (75)	**16** (25)	**20** (32)	**1** (1)	**5** (8)	0	**12** (19)

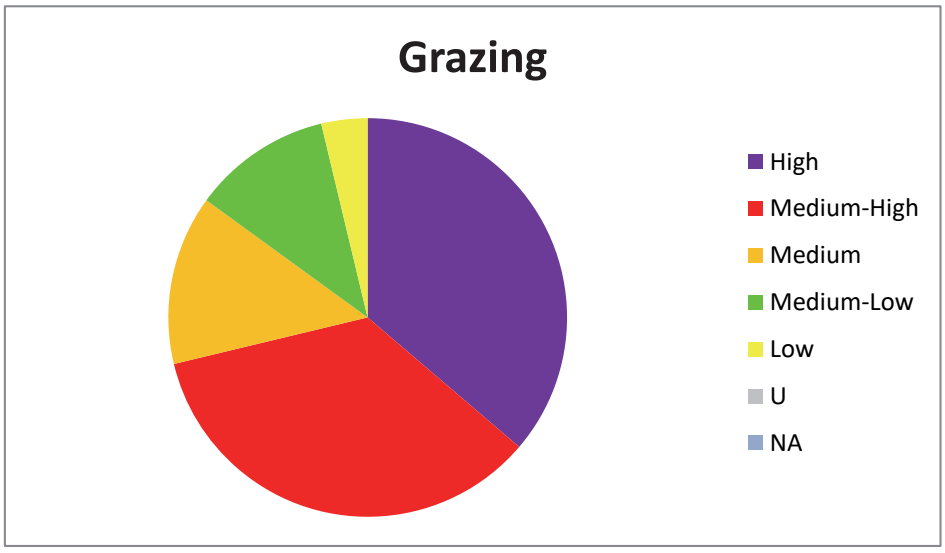

Figure 2. Grazing impacts for all habitats combined at Ben Hiant (n=160).

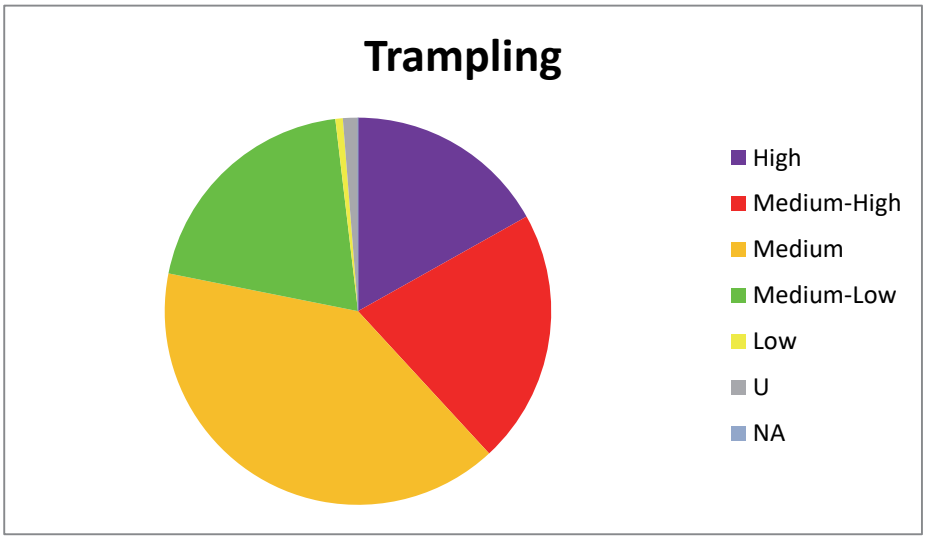

Figure 3. Trampling impacts for all habitats combined at Ben Hiant (n=160).

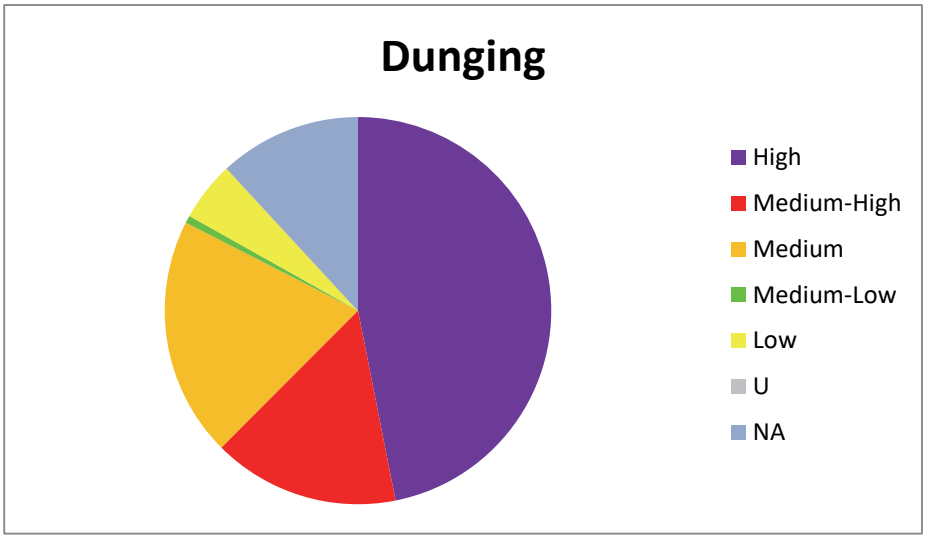

Figure 4. Dunging impacts for all habitats combined at Ben Hiant (n=160).

3.2 Grazing impact trends

Herbivore impacts trend were assessed at 160 plots in a range of habitats: Of the 160 plots assessed, 73% (117 plots) had Chronic High grazing (Table 2). The grazing indicators were Uninformative (U) for 31 of the plots. The results are summarised in Table 2 and presented as a Pie chart in Figure 5.

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

	Impact Trend					
Indicator	Chronic High	Chronic High (Decreasing?)	Chronic High-Chronic Moderate	Chronic Moderate?	Decreasing ?	Uninformative
Grazing	**68** (109)	**5** (8)	**3** (5)	**3** (5)	**1** (1)	**19** (31)

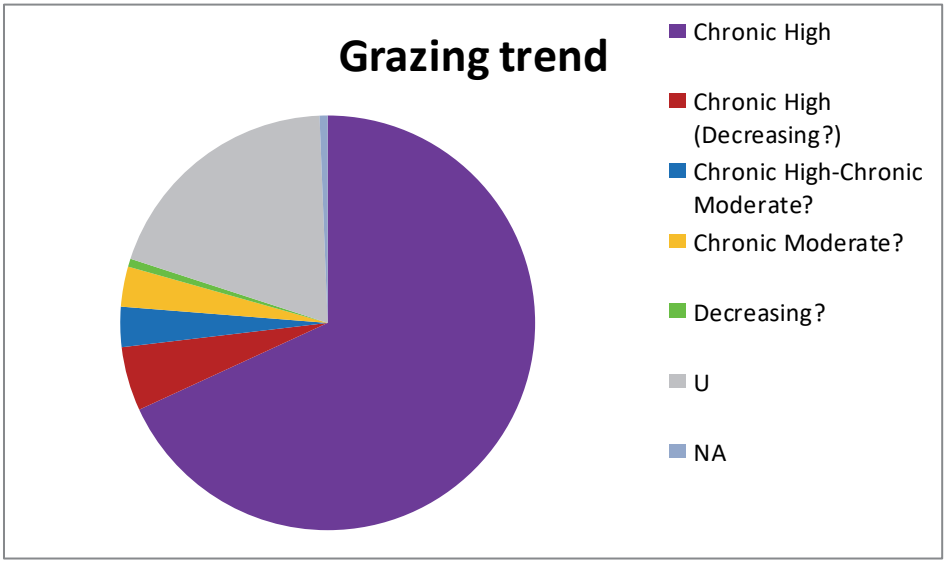

Figure 5. Grazing trends at Ben Hiant.

3.3 Blanket bog

3.3.1 Herbivore impacts on bog

Herbivore impacts were assessed at 28 plots in bog. 7% of samples (2 plots) had High grazing impacts, 39% (11 plots) High trampling impacts and 54% (15 plots) had High dunging impacts (Table 3).

Table 3. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

	Impact Class				
Indicators	High	Medium-High	Medium	Medium-Low	Low
Grazing	**7** (2)	**82** (23)	**11** (3)	0	0
Trampling	**39** (11)	**29** (8)	**32** (9)	0	0
Dunging	**54** (15)	**18** (5)	**29** (8)	0	0

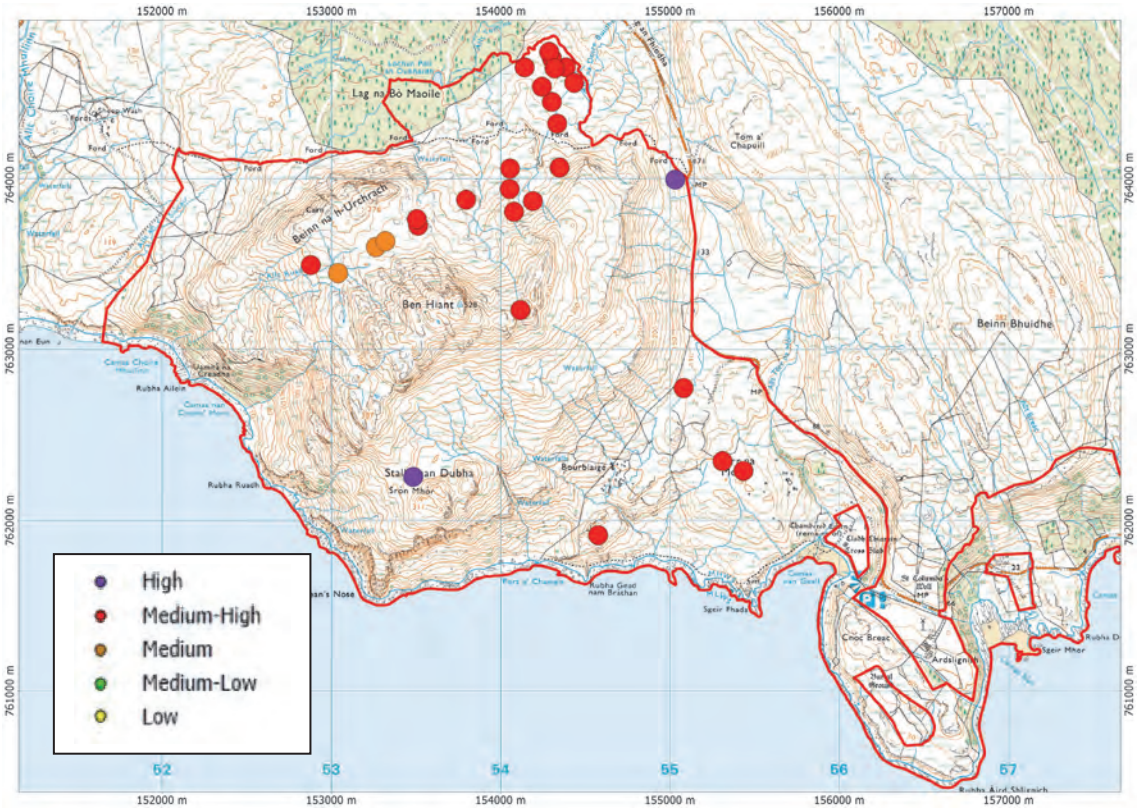

Figure 6. Grazing impacts on Blanket Bog. © Crown copyright and database right 2018. Ordnance Survey 100017908.

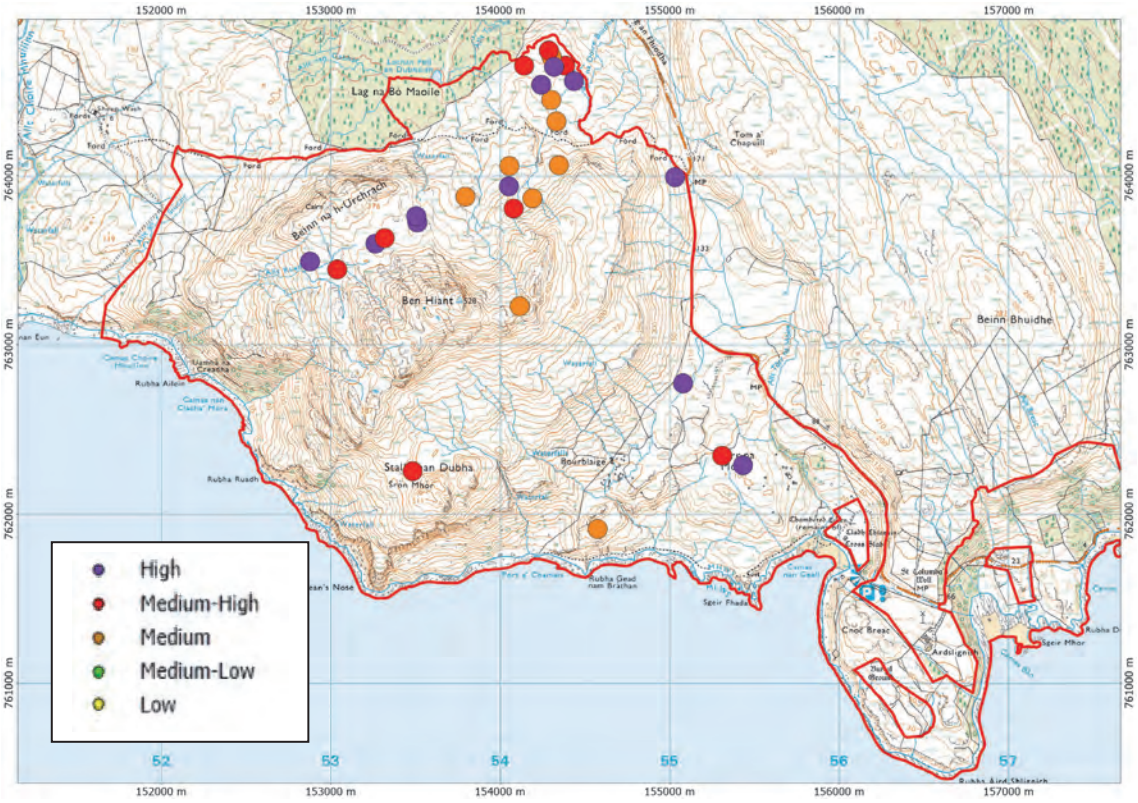

Figure 7. Trampling impacts on Blanket Bog. © Crown copyright and database right 2018. Ordnance Survey 100017908.

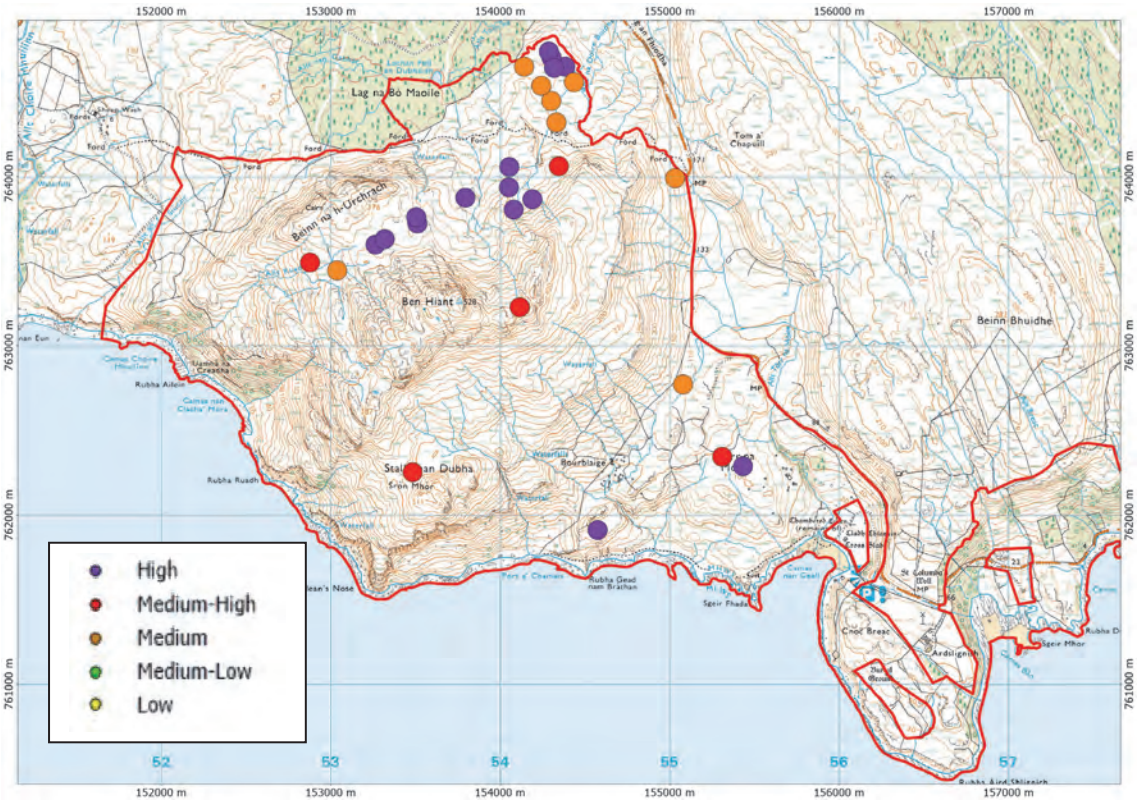

Figure 8. Dunging impacts on Blanket Bog. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.3.2 Grazing impact trends on bog

Grazing impact trends were assessed at 28 plots but the indicators were Uninformative at 5 of the plots. 96% of samples where the indicators were useful were assessed as having Chronic High grazing impacts (Table 4).

Table 4. Grazing trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

	Impact Trend			
Indicator	Chronic High	Chronic High-Chronic Moderate	Chronic High-Chronic Moderate (Decreasing?)	Chronic Moderate?
Grazing	**96** (22)	0	0	**4** (1)

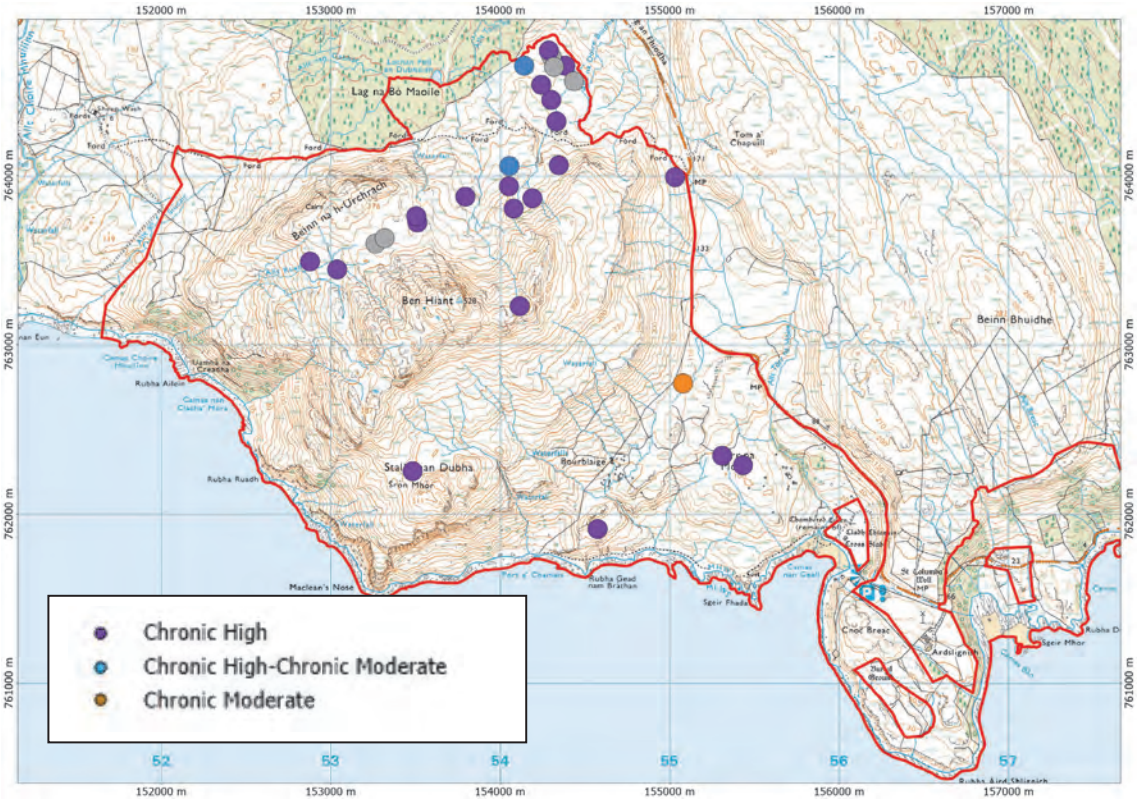

Figure 9. Grazing trends on Blanket Bog. Note grey dots indicate the impact trend was not allocated. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.4 Wet heath

3.4.1 Herbivore impacts on wet heath

Herbivore impacts were recorded at 29 plots in wet heath. 72% of samples (21 plots) had High grazing impacts, 24% (7 plots) High trampling impacts and 45% (13 plots) had High dunging impacts (Table 5).

Table 5. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

	Impact Class				
Indicators	High	Medium-High	Medium	Medium-Low	Low
Grazing	**72** (21)	**28** (8)	**0**	0	0
Trampling	**24** (7)	**24** (7)	**54** (15)	0	0
Dunging	**45** (13)	**45** (13)	**11** (3)	0	0

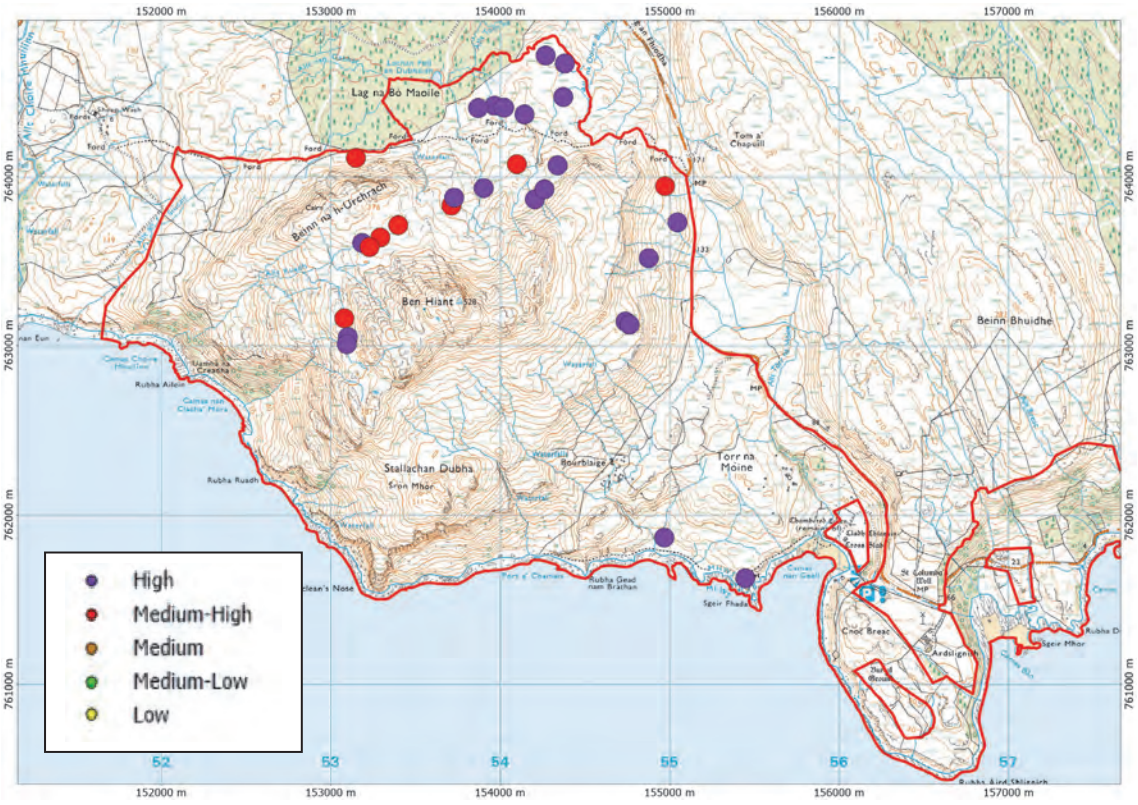

Figure 10. Grazing impacts on Wet Heath. © Crown copyright and database right 2018. Ordnance Survey 100017908.

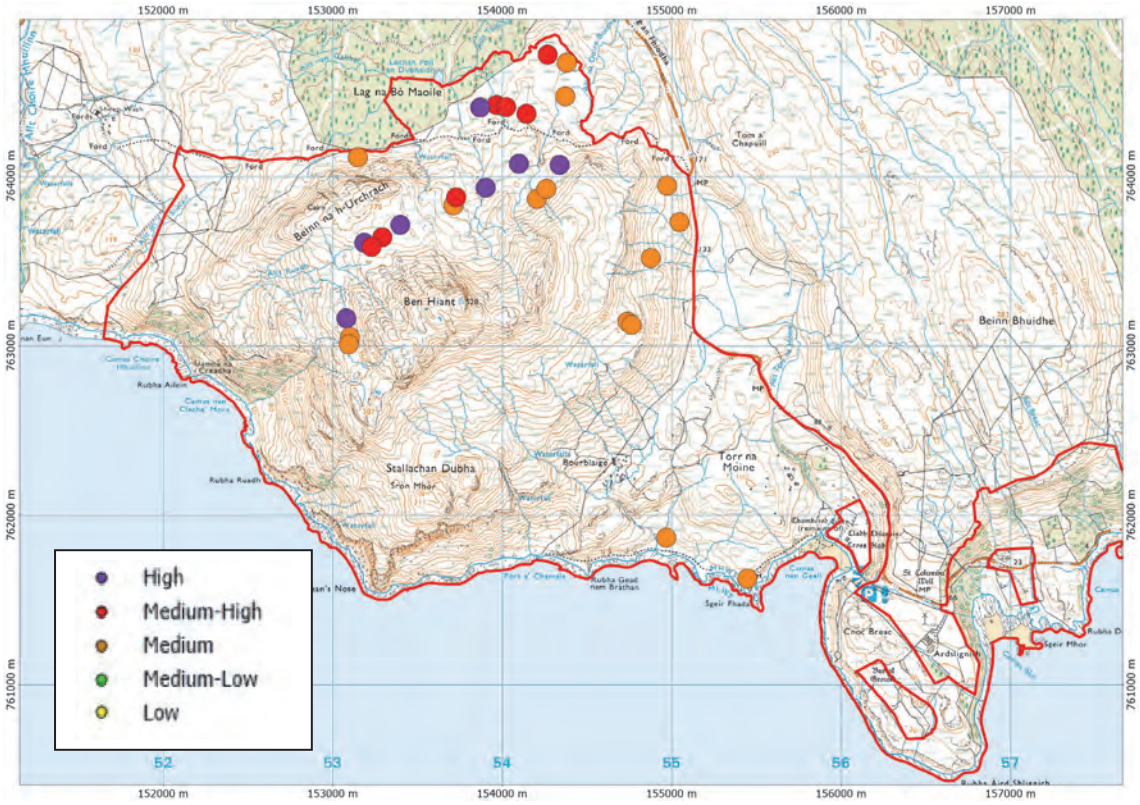

Figure 11. Trampling impacts on Wet Heath. © Crown copyright and database right 2018. Ordnance Survey 100017908).

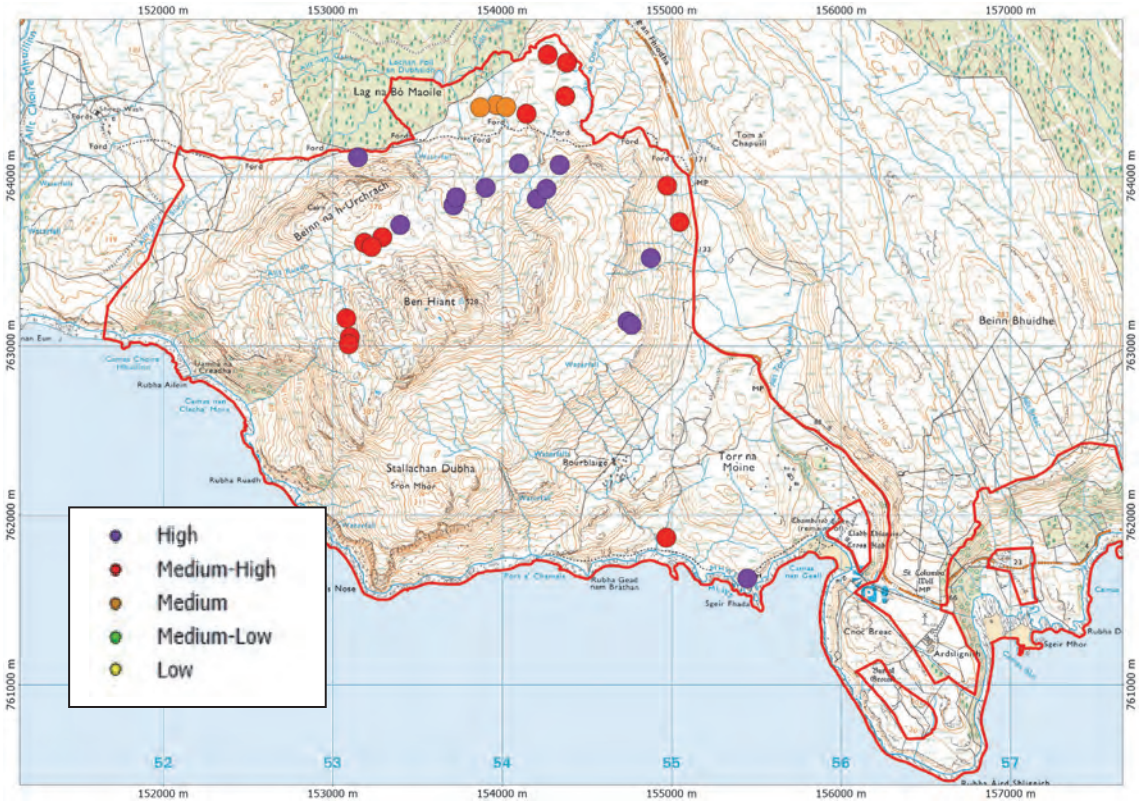

Figure 12. Dunging impacts on Wet Heath. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.4.2 Grazing impact trends on wet heath

Of the 29 plots assessed, the grazing indicators were Uninformative for two of them, but 27 were assessed as having Chronic High grazing impacts (Table 6).

Table 6. Grazing trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

	Impact Trend				
Indicator	Chronic High	Chronic High-Chronic Moderate	Chronic High-Chronic Moderate (Decreasing?)	Chronic Moderate?	Uninformative
Grazing	**100** (27)	0	0	0	2

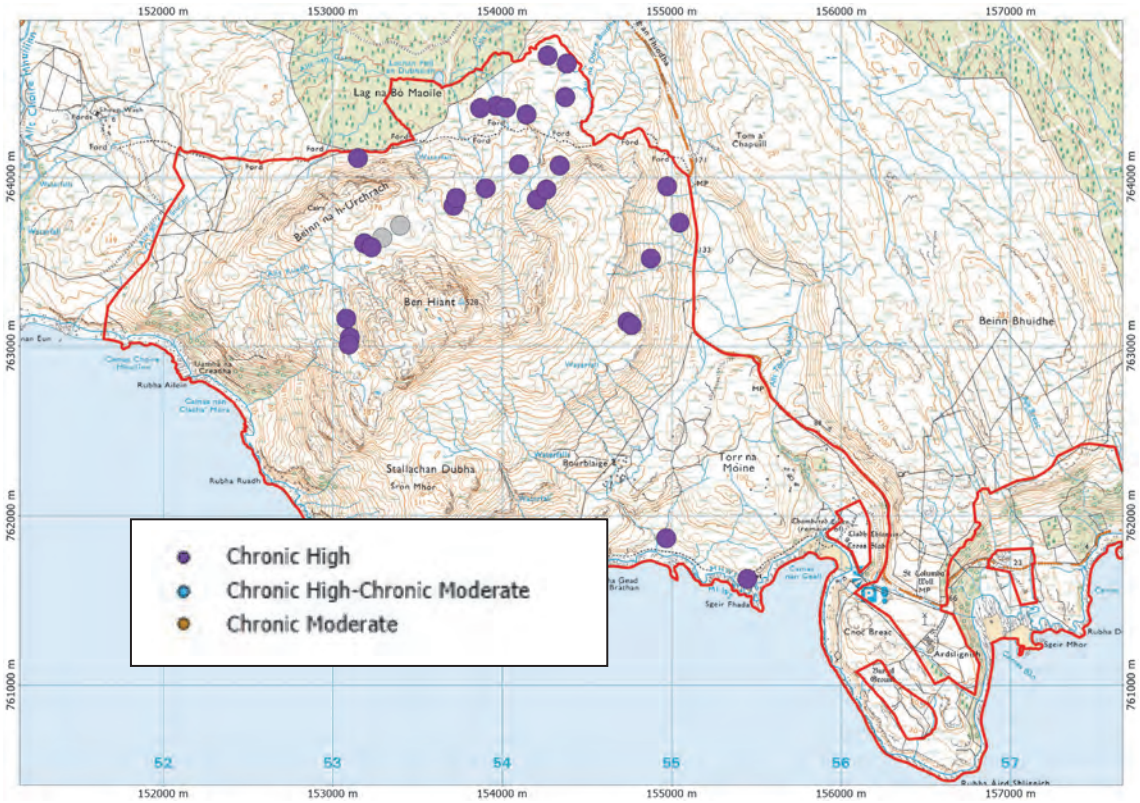

Figure 13. Grazing trends on Wet Heath. Note grey dots indicate where the impact trend was not allocated. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.5 Dry heath

3.5.1 Herbivore impacts on dry heath

Herbivore impacts were recorded at 29 plots in dry heath. All samples (29 plots) had High grazing impacts, 17% (5 plots) High trampling impacts and 72% (21 plots) had High dunging impacts (Table 7).

Table 7. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

	Impact Class					
Indicators	High	Medium-High	Medium	Medium-Low	Low	Uninform-ative
Grazing	**100** (29)	0	0	0	0	
Trampling	**17** (5)	**17** (5)	**48** (14)	**10** (3)	0	2
Dunging	**72** (21)	**10** (3)	**17** (5)	0	0	

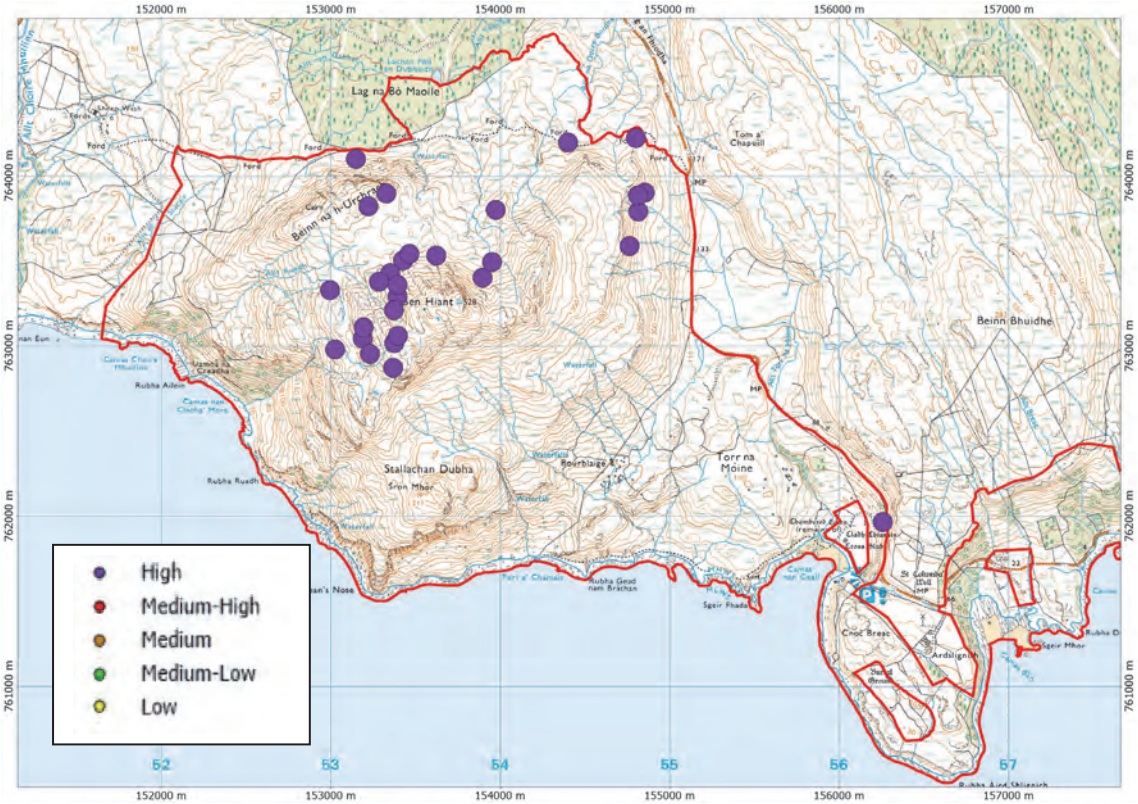

Figure 14. Grazing impacts on Dry Heath. © Crown copyright and database 2018. Ordnance Survey 100017908.

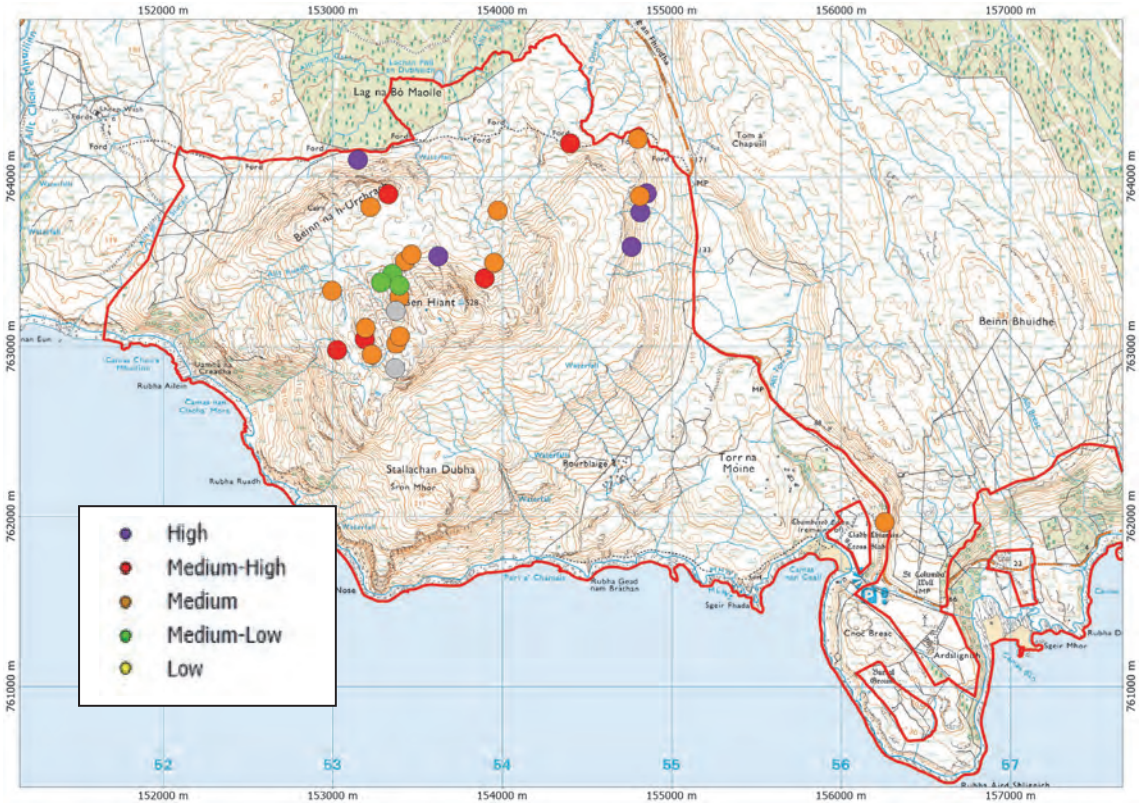

Figure 15. Trampling impacts on Dry Heath. © Crown copyright and database right 2018. Ordnance Survey 100017908.

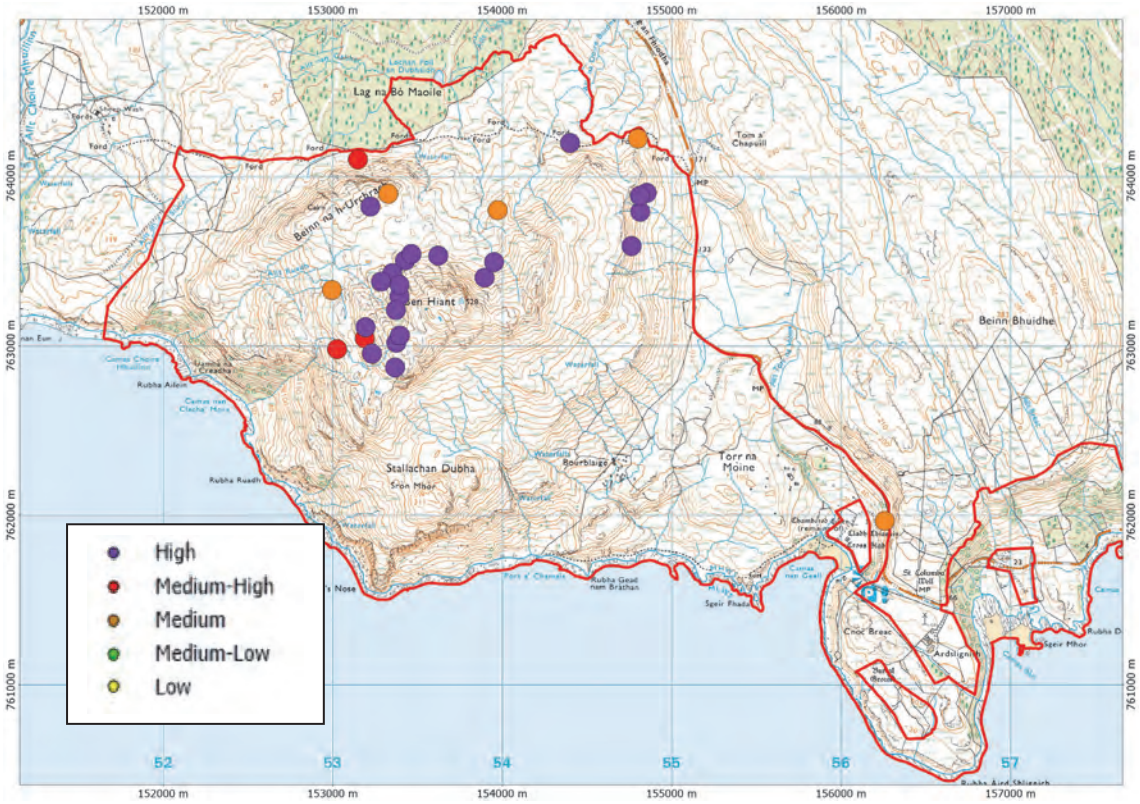

Figure 16. Dunging impacts on Dry Heath. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.5.2 Grazing impact trends on dry heath

Of the 29 plots assessed, the grazing indicators were Uninformative for one of them, but 28 were assessed as having Chronic High grazing impacts (Table 8).

Table 8. Grazing trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

	Impact Trend			
Indicator	Chronic High	Chronic High-Chronic Moderate	Chronic High-Chronic Moderate (Decreasing?)	Chronic Moderate?
Grazing	**100** (28)	0	0	0

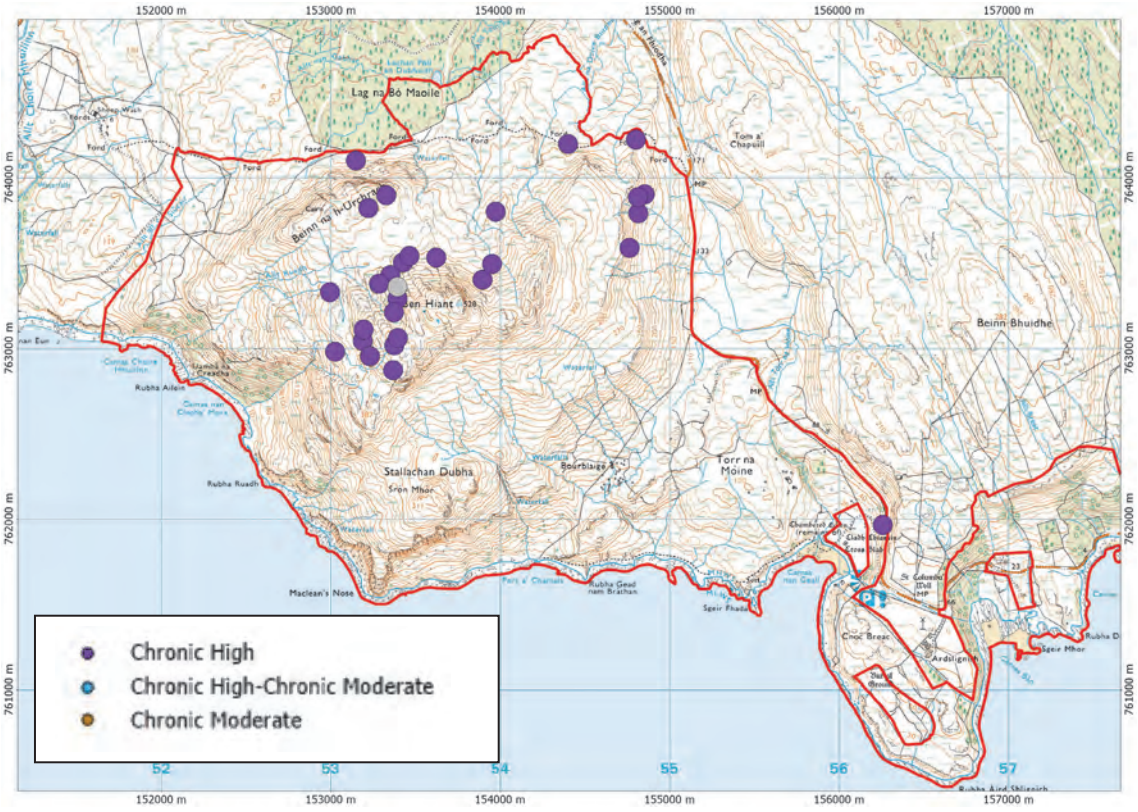

Figure 17. Grazing trends on Dry Heath. Note the grey dots indicate the impact trend was not allocated. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.6 Flush

3.6.1 Herbivore impacts on flushes

All 8 plot locations provided by SNH were visited. Of these only 3 had suitable habitat. An additional 15 patches of suitable habitat were picked up opportunistically whilst traversing the site to record plots in other habitats in an effort to record as many plots as possible. Additional targeted searching would have been required (or perhaps several plots within the same flush system) to record the full 28 plots. Herbivore impacts were recorded at 18 plots in flushes. None of the samples had High grazing impacts and 6% of samples (1 plot) had High trampling impacts (Table 9).

Table 9. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

	Impact Class				
Indicators	High	Medium-High	Medium	Medium-Low	Low
Grazing	0	**50** (9)	**28** (5)	**22** (4)	0
Trampling	**6** (1)	**39** (7)	**56** (10)	**0** (0)	0

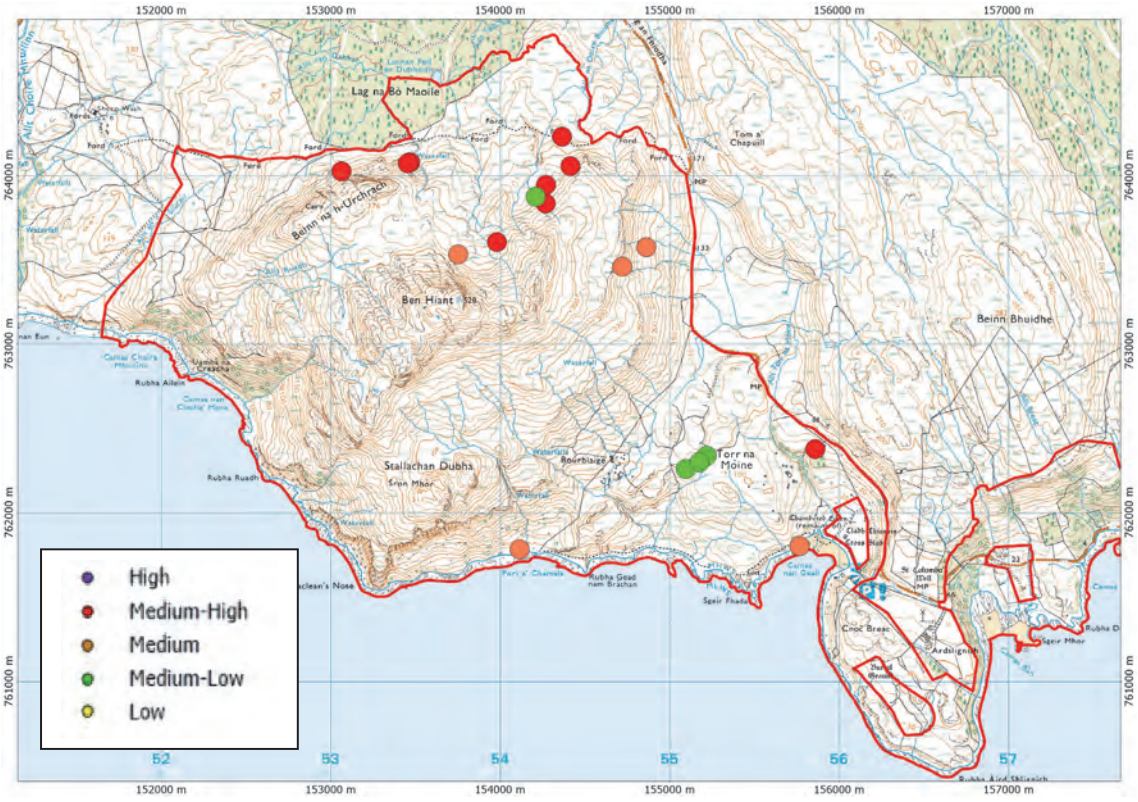

Figure 18. Grazing impacts on Flushes. © Crown copyright and database right 2018. Ordnance Survey 100017908.

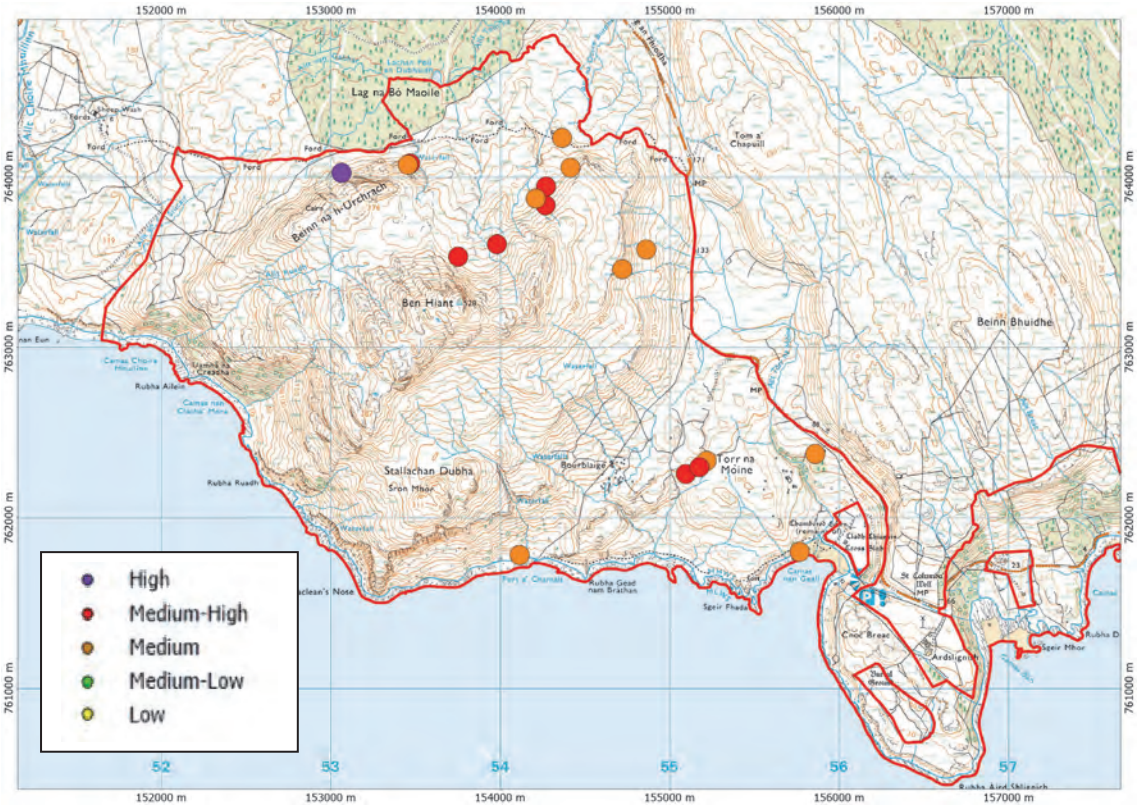

Figure 19. Trampling impacts on Flushes. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.6.2 Grazing impact trends on flushes

Of the 18 plots assessed, the grazing indicators were Uninformative for 3, but 11 were assessed as having Chronic High grazing impacts (Table 10).

Table 10. Grazing trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

	Impact Trend				
Indicator	Chronic High	Chronic High-Chronic Moderate?	Chronic High-Chronic Moderate (Decreasing?)	Chronic Moderate?	Uninformative
Grazing	**73** (11)	**20** (3)	0	**7** (1)	**20** (3)

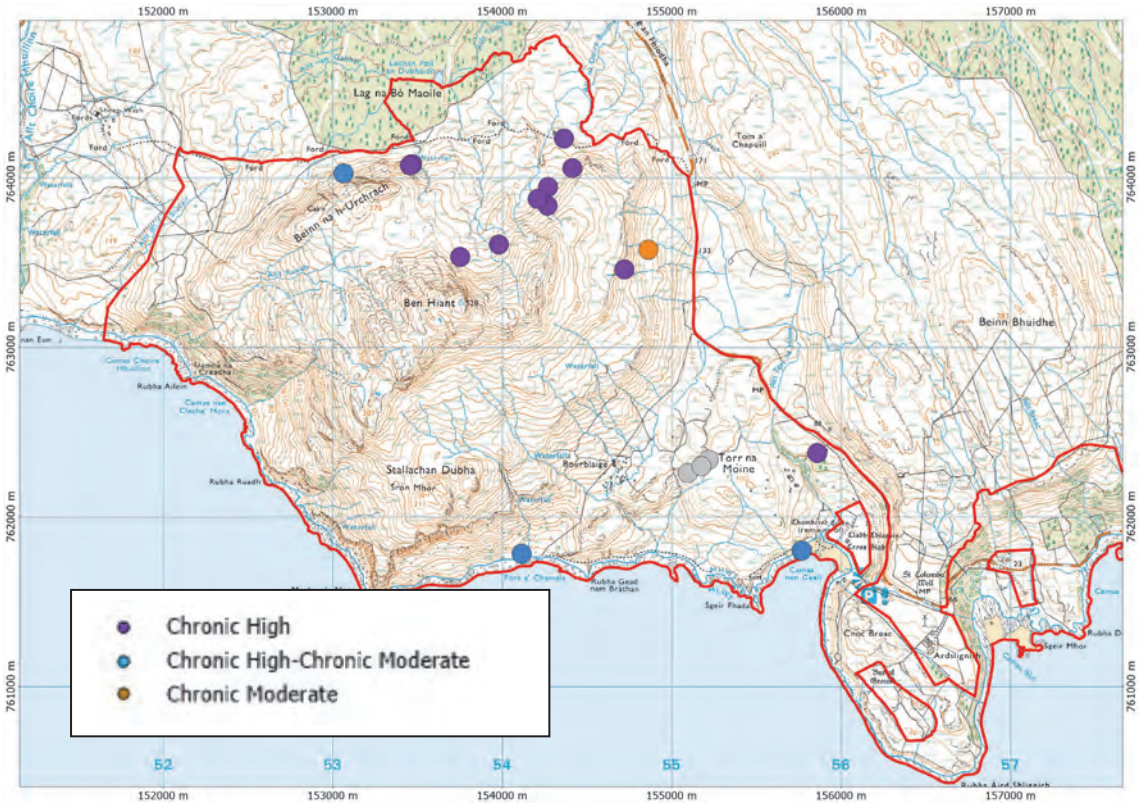

Figure 20. Grazing trends on Flushes. Note the grey dots indicate the impact trend was not allocated. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.7 Species-rich *Nardus* grassland

3.7.1 Herbivore impacts on species-rich Nardus *grassland*

Herbivore impacts were recorded at 28 plots in Species-rich *Nardus* grassland. 18% of samples (5 plots) had High grazing impacts, none had High trampling impacts and 39% (11 plots) had High dunging impacts (Table 11).

Table 11. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

	Impact Class				
Indicators	High	Medium-High	Medium	Medium-Low	Low
Grazing	**18** (5)	**36** (10)	**18** (5)	**18** (5)	**11** (3)
Trampling	0	**7** (2)	**39** (11)	**50** (14)	**4** (1)
Dunging	**39** (11)	**4** (1)	**43** (12)	**4** (1)	**11** (3)

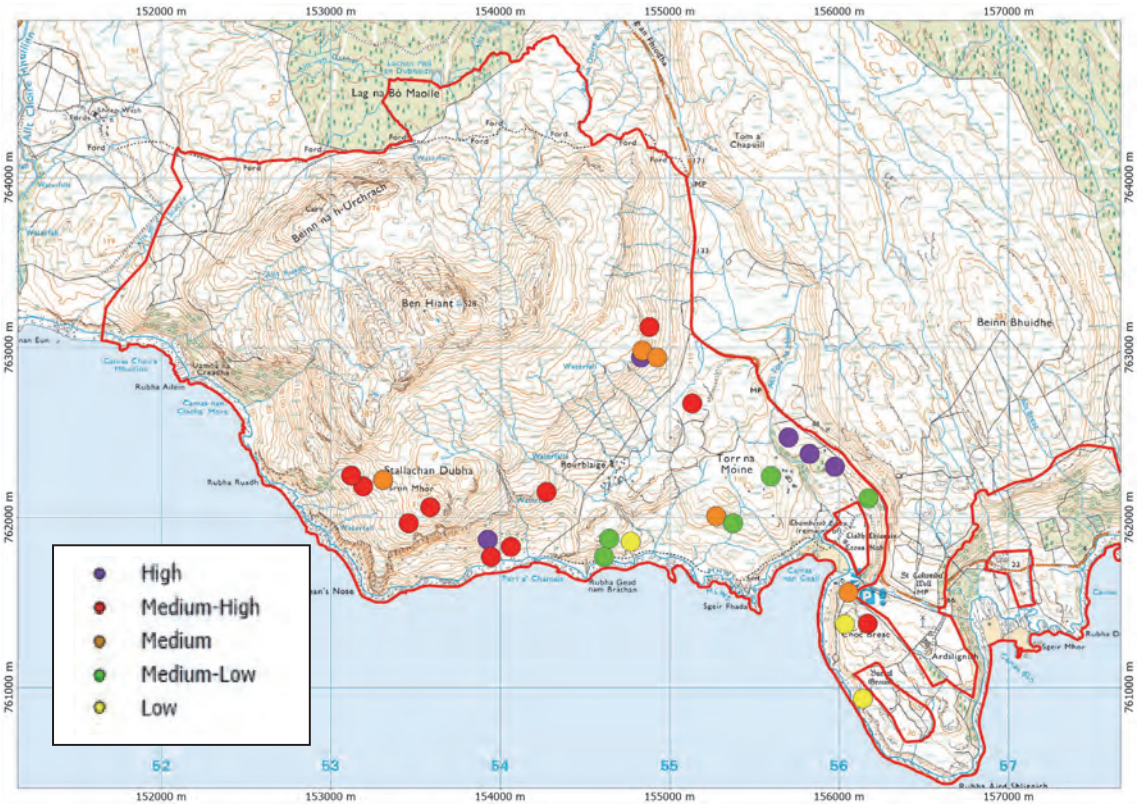

Figure 21. Grazing impacts on Species-rich Nardus Grassland. © Crown copyright and database right 2018. Ordnance Survey 100017908.

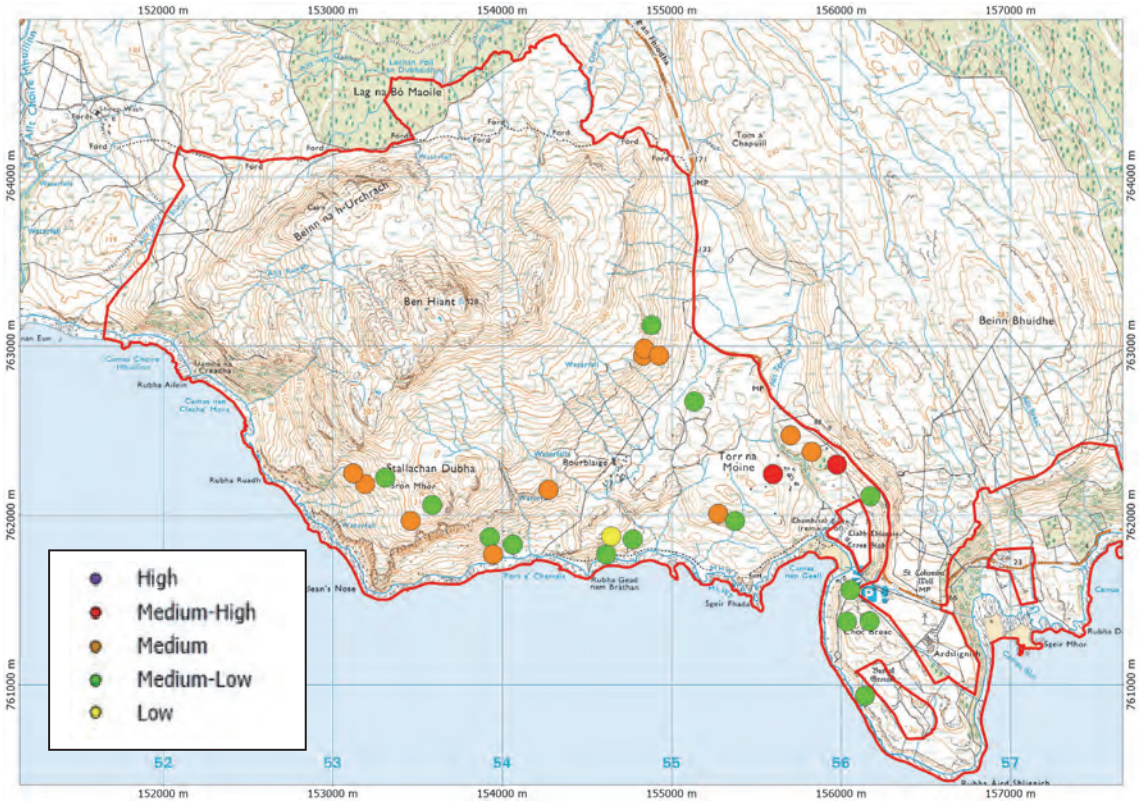

Figure 22. Trampling impacts on Species-rich Nardus Grassland. © Crown copyright and database right 2018. Ordnance Survey 100017908.

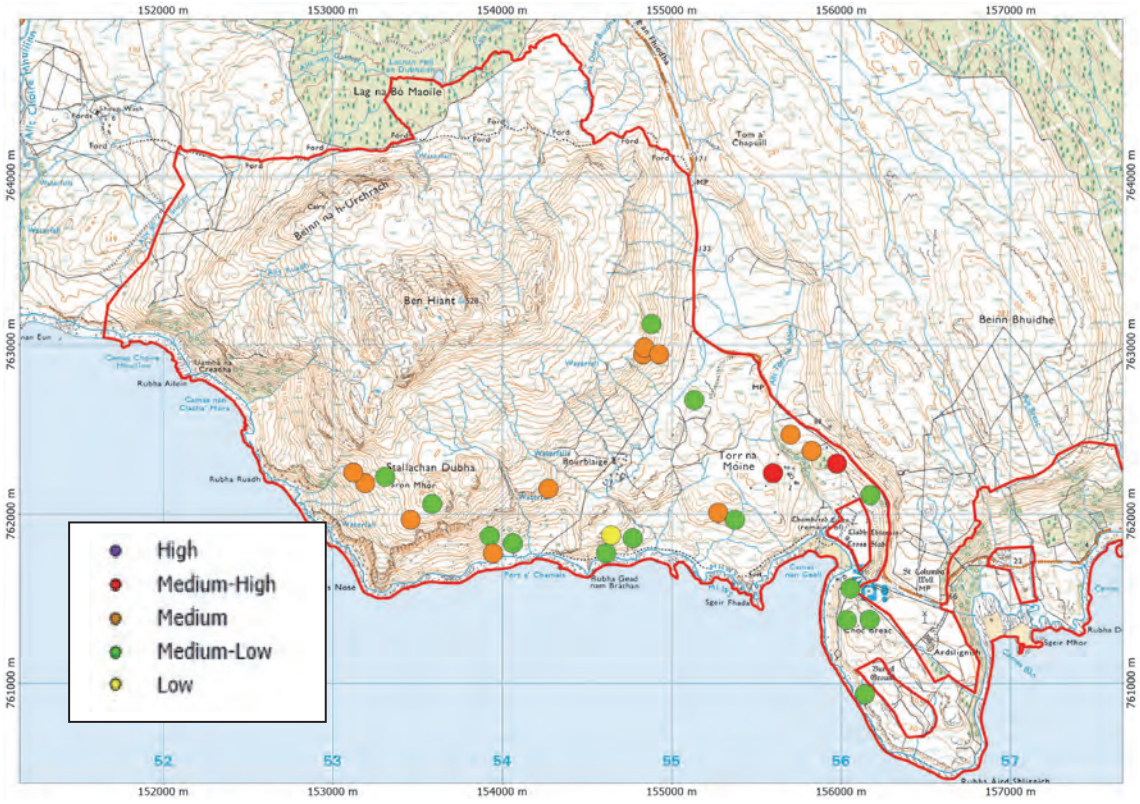

Figure 23. Dunging impacts on Species-rich Nardus Grassland. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.7.2 Grazing impact trends on species-rich Nardus grassland

Of the 28 plots assessed, the grazing indicators were Uninformative for 7 of them, but 19 were assessed as having Chronic High grazing impacts (Table 12).

Table 12. Grazing trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

	Impact Trend				
Indicator	Chronic High	Chronic High-Chronic Moderate	Chronic High-Chronic Moderate (Decreasing?)	Chronic Moderate?	Uninformative
Grazing	**91** (19)	0	0	**10** (2)	**25** (7)

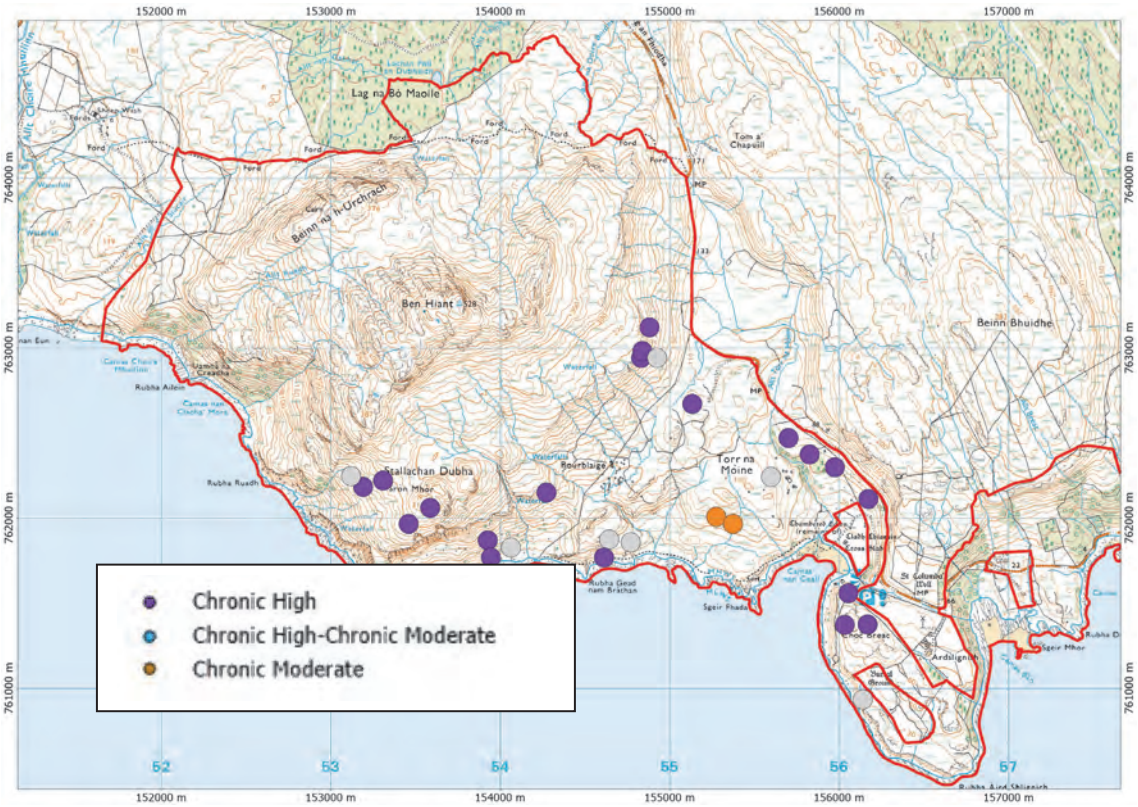

Figure 24. Grazing trends on Species-rich Nardus Grassland. Note the grey dots indicate the impact trend was not allocated. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.8 Acid grassland

3.8.1 Herbivore impacts on acid grassland

Herbivore impacts were recorded at 28 plots in acid grassland. Four per cent of samples (1 plot) had High grazing impacts, 11% (3 plots) High trampling impacts and 56% (15 plots) had High dunging impacts (Table 13). Note that one of the acid grassland plots was in tussock grassland and dunging is not assessed in tussock grassland.

Table 13. The percentage of sample points showing each impact class (with the number of plots listed in brackets).

	Impact Class					
Indicators	High	Medium-High	Medium	Medium-Low	Low	Not assessed
Grazing	**4** (1)	**21** (6)	**32** (9)	**32** (9)	**11** (3)	
Trampling	**11** (3)	**18** (5)	**18** (5)	**54** (15)	0	
Dunging	**56** (15)	**11** (3)	**15** (4)	0	**19** (5)	**4** (1)

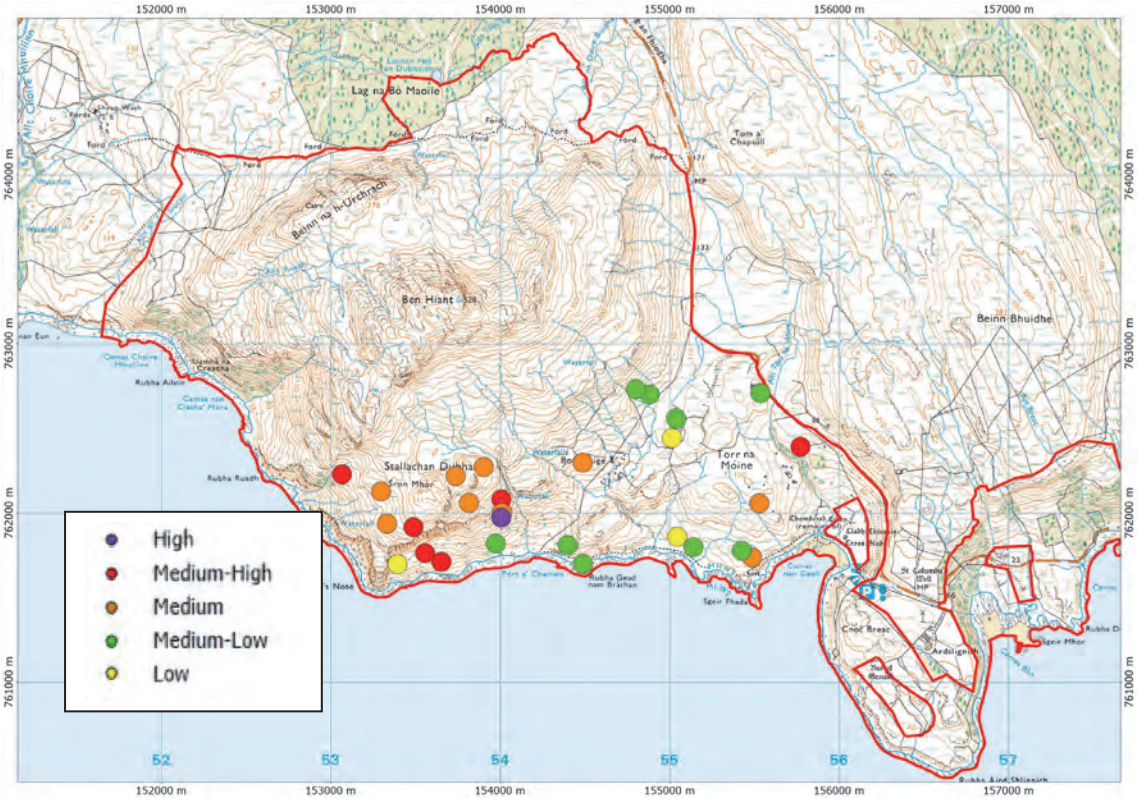

Figure 25. Grazing impacts on Acid Grassland. © Crown copyright and database right 2018. Ordnance Survey 100017908.

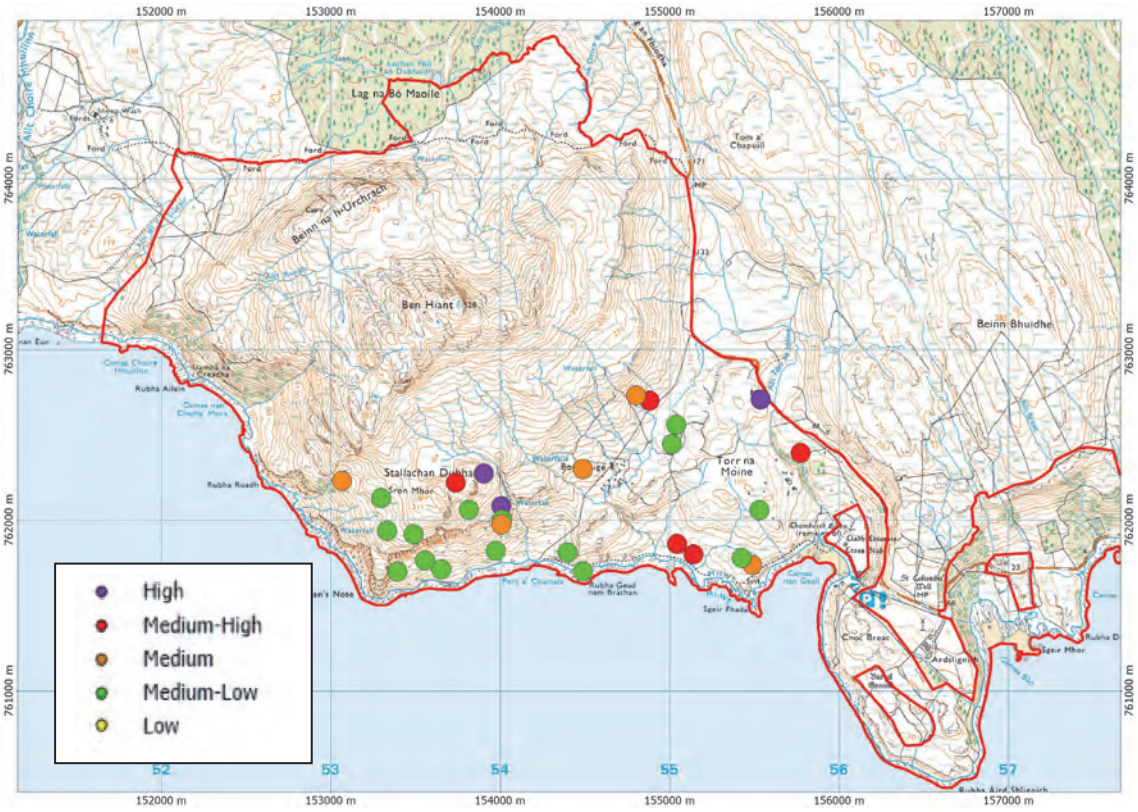

Figure 26. Trampling impacts on Acid Grassland. © Crown copyright and database right 2018. Ordnance Survey 100017908.

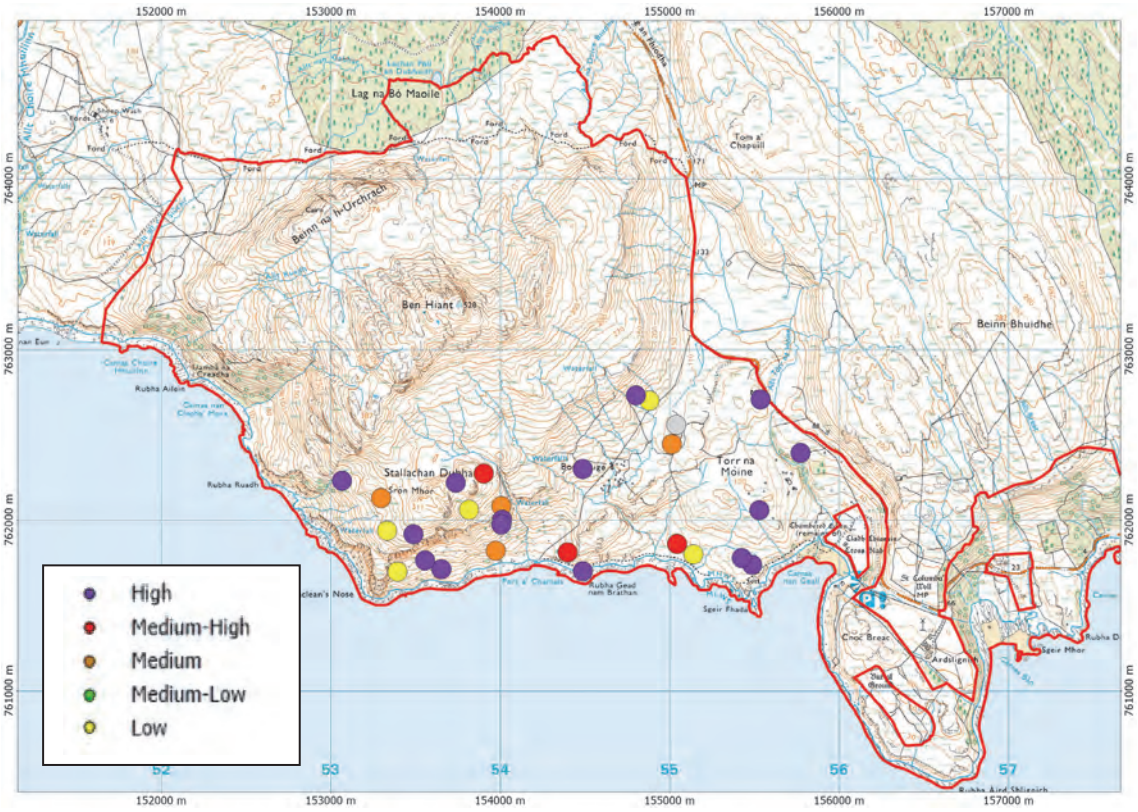

Figure 27. Dunging impacts on Acid Grassland. The grey dot indicates a plot in Tussock Grassland where the indicators for dunging where not applicable. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.8.2 Grazing impact trends on acid grassland

Of the 28 plots assessed, the grazing indicators were Uninformative for 14 of them and 12 plots were assessed as having Chronic High grazing impacts, though in 8 of these the indicators seemed to indicate that the impacts were currently Decreasing (Table 14).

Table 14. Grazing trends. The percentage of sample points showing each impact trend (with the number of plots listed in brackets).

	Impact Trend				
Indicator	Chronic High	Chronic High (Decreasing?)	Chronic Moderate?	Decreasing?	Uninformative
Grazing	**29** (4)	**57** (8)	**7** (1)	**7** (1)	**50** (14)

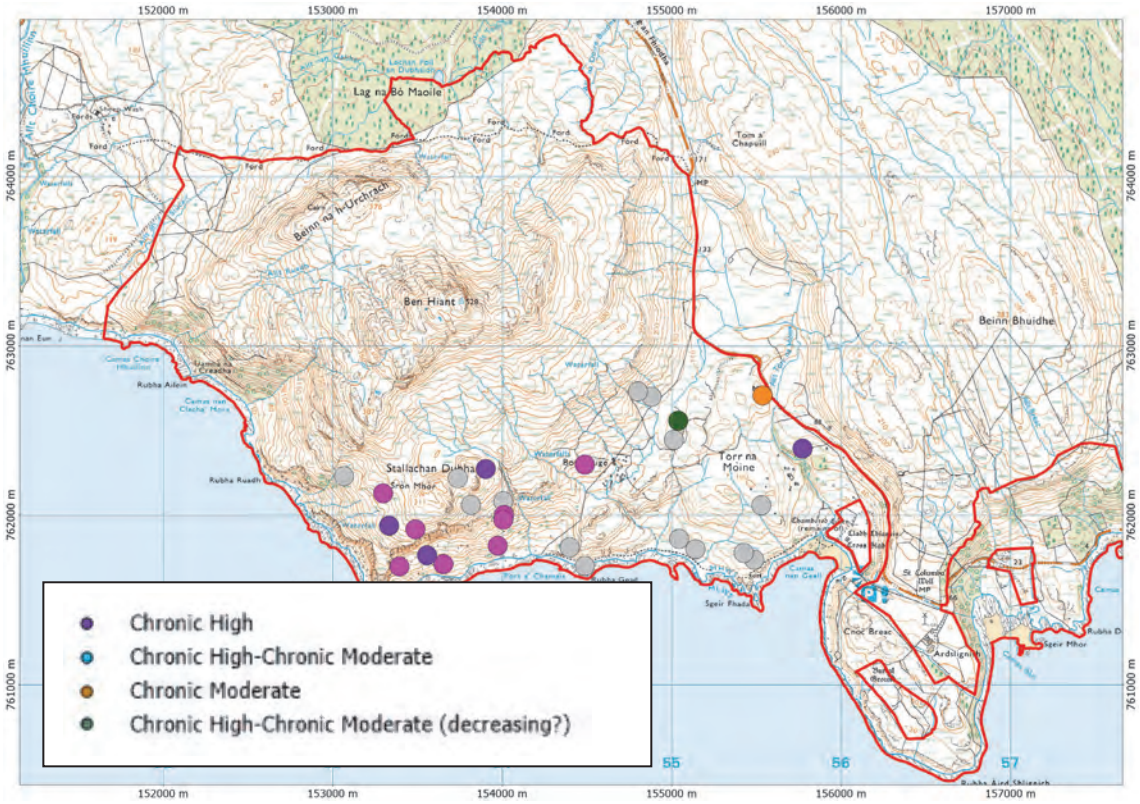

Figure 28. Grazing trends on Acid Grassland. Note the grey dots indicate where the impact trend was not allocated. © Crown copyright and database right 2018. Ordnance Survey 100017908.

3.9 Herbivores

The site is managed as upland grazing with cattle on the lower ground on the south side of Ben Hiant and sheep throughout. Approximately 30 cattle were seen around Camus nan Geall (including calves) and more cattle are present at Ardslignish too. At the start of the survey, more than 100 sheep (including lambs) were seen on the western side of the site as viewed from the public car park above Camus nan Geall, and more than 70 sheep were seen grazing at Cnoc Breac as viewed from Ben Hiant.

Stock and deer have been excluded from a small wooded gorge. Other fences limit the roaming of stock around Cnoc Breac and keep the cattle around Torr Moine and the coastal section to Port a' Chamais (they do not appear to access above c. 130m a.s.l).

It was often difficult to distinguish sheep from Red deer dung in the plots. Sheep were frequently encountered throughout the site though they were much more scarce on the more exposed west and southwest facing slopes beyond Beinn nan h-Urchraich and Maclean's Nose. Sheep scars are scattered throughout, locally frequent and in several places appear to be initiating or contributing to erosion (e.g. Figures 29, 30). Deer are present throughout (only Red deer seen but roe likely to be present locally e.g. in woodland areas) and the area is managed as a Highland Deer Estate. Only small numbers of Red deer were seen on the south side of Hiant (often solitary or a hind and calf), but the numbers may increase here after dusk. Later on in the day, large herds of hinds were seen on the north and west side of Ben Hiant. Some areas on the south side of Ben Hiant are grazed by cattle. The coastal areas grazed by cattle appear to be complex mosaics of habitats that include species-rich grasslands and herb-rich heaths.

Figure 29. Sheep scars appear to be contributing to erosion on the southeast-facing slopes of Ben Hiant.

Figure 30. Sheep scars that appear to be contributing to erosion on north-facing slopes below the east ridge of Ben Hiant

4. DISCUSSION

4.1 Rare habitats and species

Ben Hiant has an unusual geology (including limestone outcrops) that supports significant areas of Species-rich *Nardus* grassland and associated flushes (Alkaline fens). The Species-rich *Nardus* grassland is often closely associated with (and often derived from) stands of species-rich heath, *Calluna-Erica* heath, *Thymus-Carex* subcommunity (H10d). Although some of the H10d stands are not very rich with just *Thymus polytrichus* and *Campanula rotundifolia*, locally there are more species-rich stands with *Primula vulgaris*, *Galium verum* etc. H10d is a rare vegetation type and the mosaic of H10d and species-rich grassland is one of the most interesting vegetation types encountered on site. In most cases this type appears to have been impoverished by Chronic Heavy grazing and the H10d is being lost to grassland and bracken.

Other notable habitats and species recorded during the survey (including Tall herb ledges, woodland, bryophyte assemblages, lichen assemblages and invertebrates) are discussed in Annex 3.

4.2 Blanket bog

Most of the Blanket bog has been subject to Chronic Heavy grazing (96% of samples) and 82% of the samples are currently subject to Medium-High grazing, 39% to high trampling impacts and 54% to high dunging impacts. Heavy trampling and grazing leads to decline in abundance and diversity of characteristic bog species such as *Sphagna,* damage to bog features such as water tracks and pool edges and can lead to erosion (MacDonald *et al* 1998 Vol 1 section 6).

Many stands of bog are referable to the more degraded *Scirpus-Eriophorum*, *Juncus-Rhytidiadelphus* sub-community (M17c). The most extensive stands of bog were seen between Ben Hiant and Beinn na h-Urchrach (Figure 31) and in the far north-eastern corner of the site. The former area includes some areas of intact M17a bog but much of the area is subject to ongoing erosion (Figure 32) which appears to be exacerbated by deer and sheep activity (deer wallows, sheep scars, trampling). In one area the erosion was down to the mineral layer (Figure 33). The far northeastern corner also has some intact areas of M17a bog with *Sphagnum magellanicum* and some pool systems (e.g. TN42) but the pool edges are trampled (e.g. at TN43, Figure 34). There are also some *Sphagnum*-rich areas in the areas grazed by cattle. Some of these are heavily trampled by stock (sheep and cattle). Heavy trampling in *Sphagnum*-rich areas is anticipated to result in decline in *Sphagnum* cover and damage to water tracks and pool edges (MacDonald *et al* 1998 Vol 1 section 6). These areas would benefit from reduced trampling.

Ongoing heavy trampling is likely to lead to decline in the bog habitat, continued conversion of bog habitat to wet heath vegetation (e.g. M17c to M15d) and exacerbate the erosion at the watershed north of Ben Hiant. Trampling appears to be the most urgent issue as opposed to grazing.

Figure 31. An extensive area of bog between Ben Hiant and Beinn na h-Urchrach. Photo looking from Beinn na h-Urchrach towards Ben Hiant.

Figure 32. Ongoing erosion in areas of bog between Ben Hiant and Beinn na h-Urchrach.

Figure 33. In places the erosion of the bog between Ben Hiant and Beinn na h-Urchrach is down to the mineral soil.

Figure 34. trampled bog pools and pool edges at TN43.

4.3 Wet heath

Much of the wet heath is an integral part of the blanket mire complex. Many stands have been derived from bog vegetation through historical management (burning, grazing and in some areas drainage). Most of the wet heath has been subject to Chronic Heavy grazing (100% of samples) and 72% of the samples are currently subject to High grazing, 24% to high trampling impacts and 45% to high dunging impacts.

Heavy trampling and grazing of dwarf-shrub heath leads to decline in abundance and diversity of characteristic species such as dwarf shrubs including decline in average vegetation height, whilst graminoids can increase in cover (MacDonald *et al* 1998 Vol 1 section 6).

Ongoing trampling and grazing at Ben Hiant could lead to an increase in graminoids and possibly a further decline in cover of dwarf shrubs. The dwarf shrub cover was not recorded as part of this project but it was almost always a low cover, and the dwarf shrubs were suppressed to an average height of 6.8cm (Annex 4).

4.4 Dry heath

Dry heath was mainly encountered in three situations: .above c. 320m on the north and west -facing rocky outcrops and steep slopes of Ben Hiant and Beinn na h-Urchrach, on steep slopes below 320 m (below east-facing crags above the public road, and along west-facing slopes below the public road, above Camas nan Geall), and along the coastal strip on the south of Ben Hiant.

Heavy trampling and grazing of dwarf-shrub heath leads to decline in abundance and diversity of characteristic species such as dwarf shrubs including decline in average vegetation height, whilst graminoids can increase in cover (MacDonald *et al.,* 1998 Vol 1 section 6).

The higher-altitude stands were generally confined to the less accessible crags and outcrops as a result of heavy browsing (deer and sheep were seen in these areas and presumably deer target these areas in winter). On those outcrops that are more accessible the dry heath has been lost to U5e or is clearly in transition to U5e.

All of the Dry heath seen (and 100% of samples) was subject to Chronic Heavy grazing and this was ongoing (100% of plots had High current grazing impacts). Continued high impacts are likely to lead to a further decline in the Dry heath habitat with the loss of high altitude stands on all but the most inaccessible cliffs to U5e, and the loss of the H10d in mosaic with Species-rich *Nardus* grassland to grassland.

None of the H10d *Calluna vulgaris-Erica cinerea* heath, *Thymus polytrichus-Carex-pulicaris* sub-community along the coastal strip was sampled during this project. Casual observation indicates it is chronically heavily grazed. In some areas seen the high grazing appears to be sustainable (some stands were cropped short but the cover of *Calluna* was high and these were some of the more species-rich stands of H10d recorded during the survey), but in others the H10d has been lost to Species-rich *Nardus* grassland (e.g. Figure 35).

The complex mosaic of dry H10d heath and Species-rich *Nardus* grassland is probably the most interesting aspect of the Upland assemblage and should be regarded as a key characteristic of the site. It is grazing dependent and careful and flexible grazing management should be regarded as a key priority to maintain the interest. Too much grazing and more heath could be lost, too little and in many areas the bracken could become a serious problem (see section 4.7).

Figure 35. Former H10 heath that has been grazed to Species-rich Nardus grassland (Species-rich Nardus plot 13).

The heaths that are most at threat appear to be:

- The heaths on the north and west facing slopes of Ben Hiant (and Beinn na h-Urchrach). These areas are probably subject to more intensive deer browsing. The higher altitude of these heaths may also play a role, with the heaths less able to recover from heavy browsing due to a shorter growing season. In many of the stands *Calluna* has been grazed out with just chronically heavily browsed *Erica cinerea* remaining. In many cases the H10 heath is generally being lost to U5e dominated by *Racomitrium lanuginosum*. There are plenty of stands of U5e observed on rocky outcrops that have clearly been derived from H10 as a result of chronic heavy browsing.

- Heaths on the heavily sheep-grazed steep east facing slopes above the public road, which are being lost to grassland due to heavy browsing. The role of deer here is unknown. The heath is moderately herb-rich and is probably best considered as a degraded form of H10d. Bracken is also a problem in these areas.

4.5 Flush

Heavy trampling and grazing of flushes leads to decline in abundance and diversity of herbs due to physical disruption and prevention of flowering, whilst rushes may become more abundant (MacDonald *et al*., 1998 Vol 1 section 6).

Most of the flush habitat seen (and 73% of sample plots) was subject to Chronic Heavy grazing. Currently 50% of samples are subject to Medium-High grazing impacts, and 39% to Medium-High trampling impacts. Thirty nine percent of sample plots were subject to Medium-High trampling impacts and 56% as having Medium grazing impacts. One plot was assessed as having High trampling impacts - a plot on the north side of Beinn na h-Urchrach where there is a lot of deer activity.

Of the 18 flush plots, only 1 had severely disrupted bryophyte mats, 6 had significantly disrupted bryophytes (but some potentially still sustainable), 11 had limited or patchy disruption of bryophytes. It was considered that trampling impacts were higher than desirable but many of the flushes had a good cover of bryophytes (despite the disturbance) and it is possible that trampling levels in many of the flushes examined are just sustainable. Detailed monitoring would be needed to confirm this.

Some reduction of trampling is desirable for some of the flushes. Flushes (and species-rich grasslands) are more attractive to grazers so will continue to be subject to grazing with a reduction in numbers of grazers to stocking levels that permit recovery of less attractive habitats (heath and bog). Long term Chronic High-Chronic Moderate grazing has led to frequent undesirable grasses in the flushes and more locally patches of undesirable rushes. These are generally being held in check by browsing. Some level of browsing is important to prevent these grasses and rushes becoming rank, with abundant flowering and setting of seed. Regular detailed monitoring of the flushes is recommended not only to confirm the trampling levels are sustainable with regard to bryophyte mats but to monitor any potential negative impacts of a reduction in browsing (e.g. increase in *Molinia*, other grasses such as *Holcus*, *Juncus* spp. at the expense of small sedges and forbs).

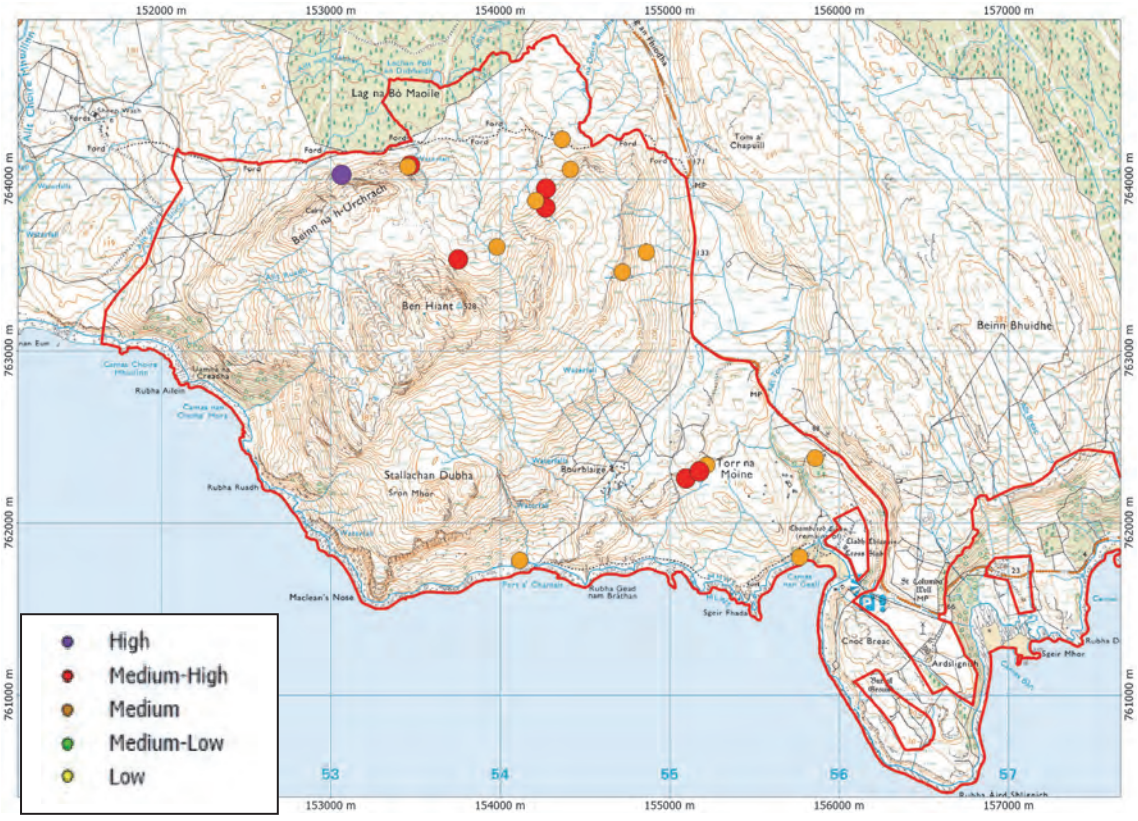

Figure 36. The disruption of bryophytes due to trampling in flushes at Ben Hiant. The colours of the dots indicate the class of the impact: purple = severe disruption, red = significant disruption (current levels of trampling potentially still sustainable, but would benefit from reduced trampling), orange = limited or patchy disruption. *© Crown copyright and database right 2018. Ordnance Survey 100017908.*

4.6 Species-rich *Nardus* grassland

Moderate grazing of Species-rich *Nardus* grassland may maintain a high diversity of characteristic flora and taller herbs may get a chance to flower; heavy grazing can maintain a moderately high diversity of characteristic flora (unless very intense, when it will decline) but restricted flowering may mean some taller herbs decline in the longer term (MacDonald *et al*., 1998 Vol 1 section 6).

Most of the Species-rich *Nardus* grassland seen (and 91% of sample plots) was subject to Chronic Heavy grazing. Most of the Species-rich *Nardus* grassland is targeted by herbivores and dung is generally much more abundant in this habitat than less productive habitats. Sheep scars are also locally frequent. However, this habitat is generally able to sustain higher herbivore impacts which might explain why only 18% of samples were assessed as having High grazing impacts (compared to say 72% of Wet heath plots). Thirty-six percentare subject to Medium-High impacts and this accounts for the dwarfed habit and scarcity of flowering of some of the forbs of this habitat (e.g. *Galium verum*, *Achillea millefolium*, *Alchemilla sp.*). None currently had High trampling impacts, but seasonally high trampling probably accounts for the local abundance of *Cirsium* spp. (especially around Cnoc Breac). Thirty-nine percent of plots had High dunging impacts. Dunging probably accounts for the presence of *Cynosurus cristatus* (locally frequent) and more rarely *Lolium perenne* in some plots (though in some areas the latter may have been sown). Some coastal stands have much *Brachypodium sylvaticum*.

Continued browsing/trampling is important to maintain this habitat and keep control of the bracken but some reduction (especially in sheep browsing) is desirable to allow some additional occasional flowering of species such as *Galium verum.* It is also important to reduce overall browsing to maintain the Dry heath in these areas (section 4.5).

The steep ground below the public road at the back of Camas nan Geall is a mosaic of Species-rich *Nardus* grassland (mostly derived from H10d) and remnant patches of H10. Bracken is invasive here and should be controlled (e.g. Figure s 37, 38). The well-drained slopes on the stretch of coast between MacLean's Nose and Camas nan Geall also have much bracken threatening grassland habitat (e.g. Figure 39, 40).

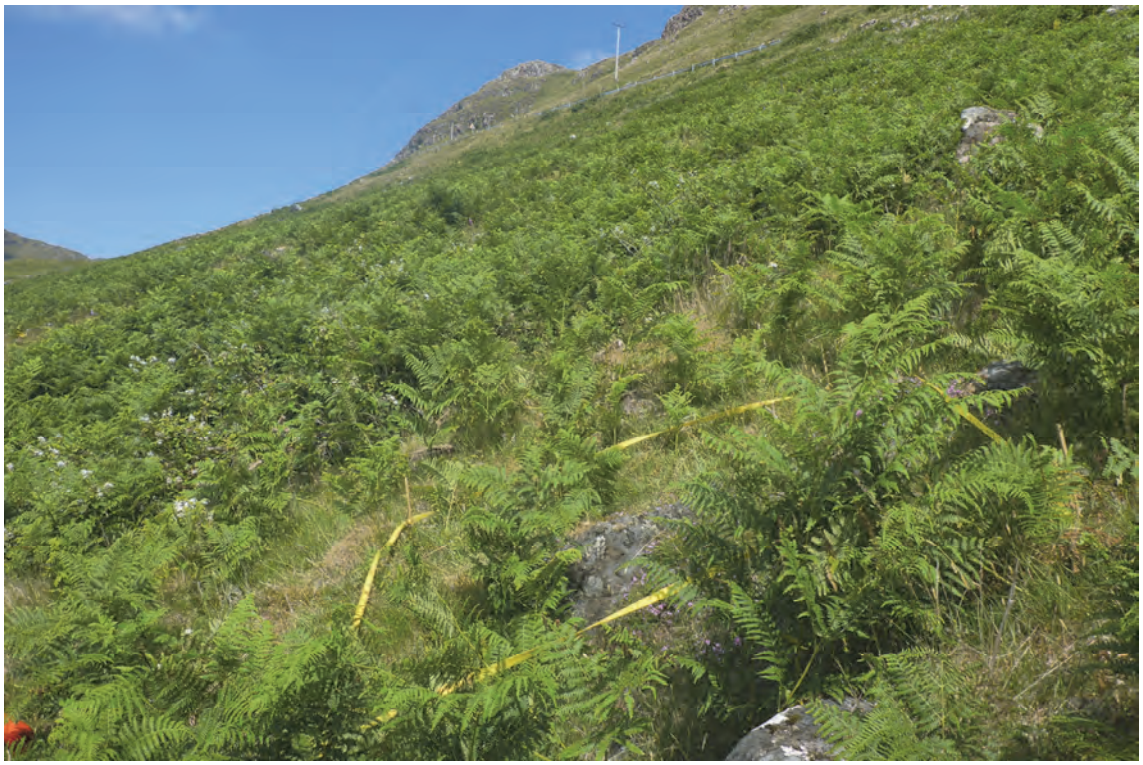

Figure 37. Bracken encroachment on Species-rich Nardus grassland on slopes between Camas nan Geall and the public road.

Figure 38. A closer view of the Species-rich Nardus plot visible in Figure 37. Note this plot is almost certainly derived from H10d by overgrazing.

Figure 39. Looking back along coast from near Maclean's nose- notice the bracken- this could potentially develop into more dense vigorous stands if grazing is reduced.

Figure 40. A closer view of the bracken patches that have encroached on the grasslands above the coastline shown in Figure 39.

4.7 Acid grassland

Moderate grazing of Acid grassland may maintain a high diversity of characteristic flora and taller herbs may get a chance to flower; heavy grazing can maintain a moderately high diversity of characteristic flora (unless very intense, when it will decline) but restricted flowering may mean some taller herbs decline in the longer term (MacDonald *et al*., 1998 Vol 1 section 6).

Most of the Acid grassland seen (and 86% of sample plots) was subject to Chronic Heavy grazing. A significant proportion (57%) was assessed as Chronic High but recorded as Decreasing? This largely relates to the indicator for presence of patches of 'weedy' species such as thistles *Cirsium* spp. which are probably a result of past (or seasonal) ground disturbance due to trampling impacts. These were mostly recorded in the areas accessible to cattle along the coastal strip on the south side of Ben Hiant and around Cnoc Breac. Currently 29% of plots in Acid grassland were assessed as subject to High or Medium -High trampling impacts (11% High, 18% Medium-High). In the authors view, the cover of

pleurocarpous mosses is an indicator of past high impacts (section 2.4) and pleurocarpous moss cover was high or medium-high in 32% of plots.

The currently observed levels of grazing impacts in Acid grassland are not high (75% in the Medium,Medium-Low or Low impact class), but the dunging data still suggests high summer herbivore activity (67% High or Medium-High dunging impacts).

One plot was within the exclosure that has been erected for the New Forest Burnet moth (section 4.9). The plot was assessed as Acid grassland but the sward was more like rank mesotrophic grassland with *Arrhenatherum elatius.* Some areas of grassland have large amounts of *Cynosurus cristatus* and, more locally *Lolium perenne* in transitions to mesotrophuc grassland MG6 (see section 4.7).

There are few concerns regarding the acid grassland itself. Acid grassland is generally able to sustain high levels of grazing. Some stands would benefit from reduced grazing, and maintaining it in good condition with a healthy cover of grasses is useful to minimise grazing pressure on nearby stands of other priority habitats (e.g. Species-rich *Nardus* grassland, dry heath). However, it should be the adjacent habitats that should dictate the upper limit to overall grazing levels in any particular area. A lower priority is to limit seasonal disturbance that would increase the abundance of thistles. At the other end of the scale – one of the main issues for significant areas of the site is to maintain a level of grazing that will not allow bracken to expand.

One of the major threats to significant areas of the site will be any increase in vigour of bracken and expansion of bracken stands if grazing/trampling is drastically reduced. Currently most stands of bracken appear to be relatively short. The relative roles of exposure, soil depth, trampling and possibly other factors are unknown but it is likely that heavy trampling is playing a role in restricting bracken vigour. Any expansion of bracken or increase in vigour will pose a serious threat to Species-rich *Nardus* grassland, Acid grassland and stands of Dry heath below c. 330m a.s.l. It is crucial to anticipate this and have in place an appropriate 'Action Plan' to control bracken before it becomes a problem. This will require regular detailed monitoring to pick up on trends at an early stage.

4.8 Comparison with previous assessments

The 2014 Upland SCM of Sunart SAC/SSSI (Wells, 2015) noted that:

> *'intensive grazing and trampling had led to significant impacts on grasslands, heathlands and flushes' [at Ben Hiant]*
>
> *'acid and calcareous upland grasslands,… localised habitats [within the SSSI], the bulk of which seems to be confined to the western part of the site around Ben Hiant, are currently experiencing high grazing impacts, mainly from sheep with resulting grazing and trampling impacts'.*
>
> *[on the south side of Ben Hiant the deer] impacts were low compared to that contributed by sheep*

5. CONCLUSIONS

The main issues, concerns and recommendations are summarised below:

- The Species-rich *Nardus* grassland and flush would both benefit from a reduction in grazing impacts. Reduction in grazing should allow more forbs to flower and set seed. A reduction in trampling would benefit the bryophyte mats within flushes.
- The current level of grazing observed on Acid grassland habitat is not high but in many areas it has been chronically heavily grazed/trampled which has led to deterioration in condition (e.g. an increase in 'feather mosses' and decrease in flowering of forbs).
- Continued high impacts are likely to lead to a further decline in the Dry heath habitat with the loss of high altitude stands on all but the most inaccessible cliffs to U5e, and the loss of the H10d in mosaic with Species-rich *Nardus* grassland to grassland.
- Trampling on the Blanket bog is leading to damage to the *Sphagnum* moss carpet/pool edges, and in some areas appears to be contributing to erosion of the bog surface.
- There has also been long term deterioration of the wider expanse of Blanket bog (including both Wet heath and Blanket bog habitats) due to past management (e.g. grazing, burning, and drainage). The blanket bog would benefit from a reduction in impacts, especially trampling.

6. REFERENCES

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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 $4m^2$ (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 15. 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 Caricion bicoloris-atrofuscae	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 Violetalia calaminariae	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 (Thlaspietea rotundifolii)	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 Rhynchosporion	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	Juniperus communis 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 Erica tetralix	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 16. 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 *Alchemilla alpina, Juncus squarrosus, Nardus stricta, Prunella vulgaris, Sibbaldia procumbens,* or *Thymus polytrichus*	G	Record %age of leaves grazed.
			• Signs of grazing (collectively) on legume species (e.g. *Lotus corniculatus, Lathyrus linifolius Trifolium repens)* or *Plantago lanceolata*	G	Record percentage of leaves grazed.
			• Signs of grazing on *Dryas octopetala*	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) *Agrostis capillaris, Anthoxanthum odoratum, Danthonia decumbens, Deschampsia flexuosa, Festuca rubra, Holcus sp, Poa sp*, 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) *Agrostis canina, Festuca ovina* and *F. vivipara.*	G	Record percentage of leaves grazed.
			• Signs of grazing on leaves of *Deschampsia cespitosa*	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**
			• Cover of mosses, particularly "feather" mosses such as *Rhytidiadelphus squarrosus, Pleurozium scheberi, Pseudoscleropodium purum, Hypnum cupressiforme* and *Hylocomium splendens.*	T	
			• Seedlings and saplings of trees and shrubs	G	
			• Breakage and uprooting of shoots of *Silene acaulis, Minuartia sedoides, Huperzia selago, Saxifraga hypnoides, Selaginella selaginoides.*	T	
			• Density of shoots of cushion-forming plants, e.g. *Silene acaulis* and *Minuartia sedoides* and occurrence of "weeding" of grasses from the cushions by grazing animals	G	
			• Amount of bare ground	T	Record what percentage of the plot has been disturbed by hoofprints.
			• Amount of dung of grazing animals (sheep and deer dung pellet groups)	D	
		Impact trends	• Grazing indicated by sward height versus grazing impact deduced from signs of grazing on plants	G	
			• Degree of flowering and vegetative state of potentially taller herbs	G	
			• Cover and frequency of small rosette-forming creeping or mat-forming herbs or dwarfed plants of taller growing species	G	
			• Presence of "weedy" species such as *Cirsium arvense, Juncus effusus, Senecio jacobaea* or *Stellaria media* in dense, extensive patches.	G	
			• Presence of trees and shrub species	G	
		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 *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**
Flush	***Alkaline fen*** ***Alpine flush*** ***Flush*** ***Petrifying springs***	Current grazing and trampling impacts	• Percentage of surface "poached" with hoof-prints	T	Record what % of the plot has been disturbed by hoofprints.
			• Disruption of moss and liverwort carpet around spring-heads and edges of rills	T	
			• Amount of pulled-up mosses and other plants	G	
			• Height of vegetation	G	Record the average height of vegetation from 10 measures within the plot.
			• 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.
			• Extent to which flowering heads of *Carex* spp. are bitten off	G	
			• Signs of grazing on *Juncus effusus, Equisetum* spp., or *Erica tetralix*.	G	
			• Amount of grazing of leaves and shoots, and amount of flowering, of *Cardamine pratensis* and *C. flexuosa*	G	
			• Vigour and degree of flowering of tall herbs *Crepis paludosa*, *Filipendula ulmaria*, *Succisa pratensis*, and *Valeriana officinalis*	G	
			• Flowering of *Armeria maritima*	G	
		Grazing impact trends	• Frequency or abundance of rushes or "grassland" species such as *Agrostis canina*, *A. capillaris, A. stolonifera, Anthoxanthum odoratum, Deschampsia cespitosa, Galium saxatile, Holcus lanatus, Juncus squarrosus, Molinia caerulea, Nardus stricta,* and *Potentilla erecta*; or *of Juncus effusus* or *J. acutiflorus*; or of *Polytrichum commune*	G	
			• Height of any bushes of *Myrica gale* and *Salix spp*.	G	

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**
Blanket bog	***Blanket Bog*** ***Wet heath (part)***	Current trampling and grazing impacts	Trampling and grazing of pool systems and water tracks	T	
			• Trampling of *Sphagnum* moss hummocks and lawns	T	Record the % of the plot covered by intact *Sphagnum* spp.
			• Extent of ground cover by bryophytes and/or lichens among and between dwarf-shrub, sedge and grass plants	T	
			• 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 *E. vaginatum.*
			• Firmness of ground underfoot	T	
			• Browsing of *Betula nana*	G	
			• Signs of browsing on *Arctostaphylos uva-ursi, Empetrum nigrum, Erica tetralix* or *Vaccinium vitis-idaea*	G	
			• Amount of flower or fruit on *Rubus chamaemorus*	G	
			• Amount of flowering of *Eriophorum* spp.	G	
			• Growth-form and evidence of browsed shoots on *Myrica gale* bushes	G	

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**
			Conspicuousness of browsing on *Calluna vulgaris* or *Vaccinium myrtillus*	G	Record the % of long-shoots of *Calluna* and/or *Vaccinium* 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 *Myrica gale*	G	
			Height and cover of dwarf shrubs relative to graminoids	G	
			Abundance of *Juncus squarrosus* and its growth relative to other vegetation components	G	
			Presence of species more typical of drier grassland such as *Agrostis canina, A. capillaris, Anthoxanthum odoratum, Deschampsia flexuosa, Festuca ovina* and *Nardus stricta*	G	
			Carex panicea 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 *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**
Dwarf shrub heath	***Dry heath*** ***Wet heath (part)***	Current browsing impact	• Signs of browsing on *Arctostaphylos uva-ursi, Empetrum nigrum, Erica tetralix* or *Vaccinium vitis-idaea* (or associated *Nardus stricta)*	G	
			• Average proportion of long-shoots of *Calluna vulgaris* and/or *Vaccinium myrtillus* showing signs of having been browsed	G	Record the % of long-shoots of *Calluna* and/or *Vaccinium* 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 flower or fruit on *Calluna vulgaris* and/or *Vaccinium myrtillus*	G	
			• Summer browsing of *Calluna vulgaris*	G	
			• Type of shoot material removed from *Calluna vulgaris* and/or *Vaccinium myrtillus*	G	
			• Growth-form and evidence of browsed shoots on *Myrica gale* bushes	G	
			• Uprooting of dwarf-shrub seedlings in recently burnt patches	G	
			• Stem breakage as a result of trampling by larger herbivores (check for hoof prints)	G presumably T	
			• Depth of carpet mosses and liverworts or “bushy” *Cladonia* lichens, under and between the dwarf-shrubs	T	
			• Amount of trampled, bare ground	T	

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**
			• Amount of herbivore dung present	D	
		Grazing impact trends	• Growth-forms of *Calluna vulgaris* and/or *Vaccinium myrtillus*	G	
			• Changes in growth form recorded within the structure of dwarf-shrub bushes	G	
			• Presence of “drumstick”, “topiary” and “carpet” growth forms	G	
			• Height and cover of dwarf-shrubs relative to graminoids	G	
		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 *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**
Tussock grassland	***Acid grassland (part)***	Current grazing and trampling impacts	• Signs of grazing on *Nardus stricta* tussocks, where sheep or red deer are the principal grazing animals.	G	
			• Signs of grazing on *Nardus stricta* tussocks, where cattle are the principal grazing animals	G	
			• Average inter-tussock sward height.	G	Record the average inter-tussock sward height from 10 measures within the plot.
			• Accumulation of dead plant litter.	G	
			• Signs of grazing of less palatable species (other than tussock-formers) such as *Juncus* spp., *Cirsium* spp. *Galium saxatile*, *Potentilla erecta*, mosses.	G	Record %age of leaves grazed.
			• Flowering of associated herbs in inter-tussock vegetation (June - August).	G	
			• Signs of grazing on leaves of (collectively) *Agrostis capillaris*, *Anthoxanthum odoratum*, *Danthonia decumbens*, *Deschampsia flexuosa*, *Festuca rubra*, *Holcus* spp., *Poa* 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.
			• Signs of grazing on leaves of (collectively) *Agrostis canina*, *Festuca ovina*, and *F. vivipara*.	G	
			• Signs of grazing on the leaves of *Deschampsia cespitosa*	G	
			• Seedlings and saplings of trees and shrubs > 5 cm tall.	G	
			• Amount of bare ground.	T	
			• Cover of mosses, particularly *Polytrichum commune* and “feather” mosses such as *Pleurozium schreberi* and *Hylocomium splendens*.	T	
		Grazing impact trends	• 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 *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**
			• Degree of flowering and vegetative state of potentially taller herbs *e.g. Succisa pratensis* (see also ***Tall herbs***).	G	
			• Abundance and relative growth of *Juncus squarrosus* and other small, rosette-forming, creeping or mat-forming herbs (*e.g. Galium saxatile*, *Polygala serpyllifolia*, *Potentilla erecta*, *Viola palustris*), or dwarfed plants of taller growing species, in the inter-tussock vegetation.	G	
			• Cover of mosses, particularly *Polytrichum commune* and "feather" mosses such as *Pleurozium schreberi* and *Hylocomium splendens* versus what is deduced from other indicators.	G	
			• Presence of tree and shrub saplings versus sward height.	G	
		Herbivore species present	• Record which herbivore species are present and whether impacts are clearly attributable to one or more species.		

ANNEX 3: OTHER HABITATS

During the course of the HIA causal observations were made on several other habitats and features that are not part of the notified Upland assemblage feature (and so not formally assessed as part of this contract). These are discussed below in sections 4.9.1 to 4.9.5.

Tall herb ledges

The main stands of tall herbs seen were associated with cliffs on the north face of Ben Hiant. (Figure 41) but also other stands with Roseroot were seen on outcrops on north and west facing slopes of Ben Hiant and outcrops on north-facing slopes of Beinn na h-Urchrach There are likely to be other stands elsewhere but they are likely to be confined to inaccessible ledges.

Figure 41. Locations of some of the larger stands of Tall herbs seen at Ben Hiant.

Woodland

The site includes a significant woodland along the west coast (notably the woods at Uamha na Creadha with oak, ash and hazel), some small stands of coastal woodland on the south side of Ben Hiant and Cnoc Breac, some sycamores around the old graveyard, and some ravine woodland along the Allt Tòr na Mòine (Figure 42). None of the woodland was assessed as part of this project but the coastal woodland at Camas nan Geall was walked through and includes regenerating trees (e.g. TN21). Small stands of remnant coastal woodland were seen further west above the coast (e.g. c. NM548620, Figures 43, 44) and the bracken slopes here would appear to be a perfect for a small woodland regeneration scheme.

The ravine woodland has been fenced and some regeneration was seen. The exclosure is a good illustration of what can happen to well drained areas of the site if grazing is drastically reduced/removed - an explosion of bracken. An ‘old woodland’ community of *Lobarion* lichens has been recorded from Allt Tòr na Mòine including some notable species. Too

much tree regeneration can pose a threated to the more light-demanding lichens. Cattle should be allowed to graze this area as soon as a scattering of tree regeneration has successfully established, to minimise negative impacts on the lichen flora and in an attempt to reduce the vigour of the bracken.

A lichenologist should be consulted before erecting any new exclosures that include stands of old/veteran trees.

Figure 42. The woodland exclosure around the ravine woodland along the Allt Tòr na Mòine. Note the dense bracken that develops with exclusion of browsing.

Figure 43. Coastal woodland remnants c. NM548620. The woodland would have been more extensive here in the past and the bracken slopes would be perfect for a small woodland regeneration scheme.

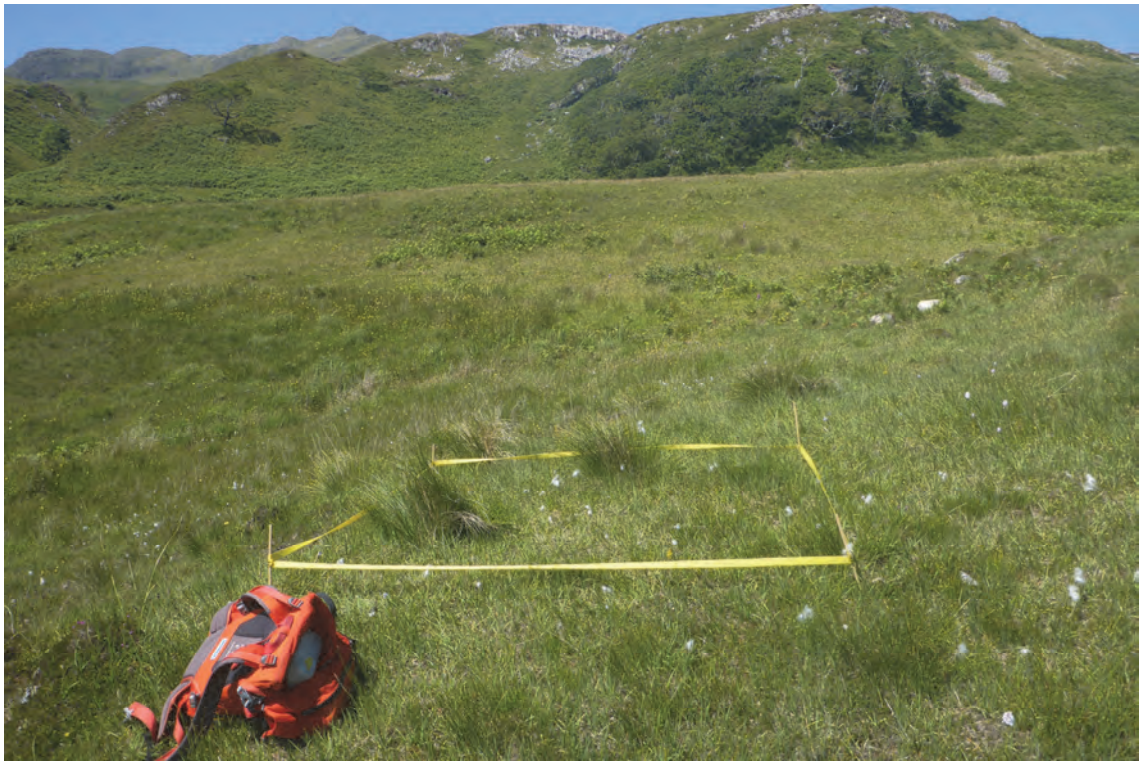

Figure 44. A closer view of the remnant shown in Figure 43.

Lichen assemblage

Some notable species were recorded during the survey work including the Nationally Rare Scottish Biodiversity List (SBL) lichen *Dictyonema coppinsii* growing on bryophytes on a rock outcrop on the north side of Ben Hiant.

The woodland supports an 'old woodland' flora for example oceanic *Lobarion* lichens. Other lichens (from NBN Atlas, 2018) include the Nationally Rare Red Listed Near Threatened SBL species *Gyalidea fritzei* on north slopes Ben Hiant, the Near Threatened Nationally Rare Scottish Biodiversity List species *Polyblastia terrestris,* the Nationally Rare *Polyblastia theleodes* the Nationally Rare *Pyrenocarpon thelostomum* and a large number of Nationally Scarce species including *Koerberiella wimmeriana, Lempholemma botryosum, Pertusaria chiodectonioides, Porocyphus coccodes* and *Toninia thiopsora*. A number of these lichens occupy grazing-dependent niches that could potentially be smothered by a rank vascular flora so a lichenologist should be consulted before excluding stock from any areas with rock outcrops.

Bryophyte assemblage

The bryophyte flora is unknown but a bryologist should be consulted to check the impacts of changes in grazing regimes. The north side of Hiant supported stands of H21 (some of which were sampled during the HIA) and some stands of this community can support a Northern Atlantic hepatic mat.

Invertebrates

MacLean's Nose on Ben Hiant is the only known site for the Red Listed Vulnerable New Forest Burnet moth (*Zygaena viviae* subsp. *argyllensis*). The New Forest Burnet moth exclosure at Maclean's Nose includes stands of Species-rich *Nardus* grassland with abundant flowering forbs (including flowering *Galium verum* which was mostly stunted and not flowering elsewhere on site).

The latest available information (from Mike Smedley, SNH) is that:

> *"the area favoured by burnet moths is currently subject to a management agreement which involves a controlled grazing regime"*
>
> *and*
>
> *'the moth is subject to annual surveys and has been assessed in SCM cycles 1 to the 3, as Favourable maintained. The most recent SCM Management note (internal SNH document A2166259) mentions that the exclusion of stock from the site in the late 1990s resulted in an increase in the moth population. More recently, it has been noted that the vegetation has been at risk of becoming too rank, and whilst the distribution and abundance of the essential food plants has not changed significantly, greater variability in numbers has been recorded in cycle 3 than in the previous cycle.*

The grassland was very rank in summer 2018 (Figure 45) and is likely to become less species rich over time as small forbs are outcompeted. Some grazing is desirable to maintain a species-rich sward, and the exclosure looked seriously undergrazed during the survey.

Yellow Meadow ant nests are locally abundant along the coastal strip to the south of Ben Hiant. Although not uncommon in western Scotland these are an interesting grazing-dependent feature.

Figure 45. Rank grassland within the exclosure at MacLean's Nose.

ANNEX 4: DATA

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

ANNEX 5: PHOTOGRAPHS

This annex can be provided on request.

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