



Forestry Commission Scotland

**Loch Katrine Habitat Impact
Assessment Report**

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EXECUTIVE SUMMARY

RPS was commissioned by Cowal and Trossachs Forest District to complete Habitat Impact Assessment (HIA) surveys of the land surrounding Loch Katrine, Stirlingshire. Surveys were required to assess the current level of impacts from browsing and grazing by herbivores across the survey area throughout the previous winter months.

Historically, high levels of browsing and grazing have taken place within the survey area, both from domestic livestock and from deer and goats associated with the national forest estate and the surrounding sporting estates. Such impacts from herbivores have affected the habitats present across the area, reducing the abundance of heath habitats, as listed on Annex 1 of the European Habitats Directive. Erection of a deer fence around the lower slopes of Loch Katrine has sought to control herbivore numbers within this area, with the aim of increasing the presence of heath habitats by suppressing the preferential browsing of heath species during the winter months.

A 120 point survey was designed to assess the herbivore impacts to the land surrounding the north and west of Loch Katrine, with 60 monitoring points above and 60 below the deer fence line. The locations were split 50:50 between grassland and heathland habitats (as identified through data from a previous National Vegetation Classification (NVC) survey of the area). Grassland habitats for the purpose of the surveys were further divided into smooth or tussock grassland types.

At each monitoring point parameters associated with herbivore impacts were measured. These were based on Scottish Natural Heritage (SNH) Best Practice Protocols and MacDonald et.al. (1998) - A Guide to Upland Habitats Surveying Land Management Impacts. 2. Parameters recorded were dependent on the habitat type the monitoring point was situated in.

The results of the Loch Katrine Habitat Impact Assessment survey indicate a trend of high herbivore pressure to the heathland habitats above the deer fence line, with continuing moderate / decreasing to low pressure below the fence line. The results indicate that a population of deer still exists, albeit at suppressed levels due to stalking activities below the fence line which is reducing the impact of herbivores on ling heather and heath species in general, along with allowing a degree of natural regeneration by tree species.

Trends and impacts to grassland habitats appear to be lower than those to heathland habitats; however this may be in part due to the timings of the surveys and the seasonal utilisation of habitats. However, ongoing monitoring of grassland habitats and the coverage / regeneration of heath species at these locations will be important in determining if the long terms aim of expanding heath habitat abundance is succeeding.

In conjunction with continuing to monitor the impacts of herbivores to the habitats present at each of the 120 locations on a regular basis, comparing the results of the monitoring to deer population survey results would provide additional information on the pressures from herbivore utilisation. Similarly, completing a large scale Effective Deer Utilisation survey to look at over-wintering land use by deer species may be an additional effective survey to provide specific data with regards to herbivores, their use of the Loch Katrine area, their impacts on key habitats, and the ongoing management required to meet the aims and objectives of the land in the medium- to long-term.

1. INTRODUCTION

1.1 Background

RPS was commissioned by Cowal and Trossachs Forest District, through Forestry Commission Scotland (FCS) Framework FW0015 for Ecological Services, to complete Habitat Impact Assessment (HIA) surveys of the land surrounding Loch Katrine, Stirlingshire (central Ordnance Survey (OS) grid reference NN 4209 9763). The survey covered the hillsides to the north and west of the loch; an overview of the survey area is provided in Figure 1 for reference.

Surveys were required to assess the current level of impacts from browsing and grazing by herbivores across the survey area throughout the previous winter months. Historically, high levels of grazing have occurred within the survey area, both from domestic livestock and from deer and goats associated with the national forest estate and the surrounding sporting estates. National Vegetation Classification (NVC) surveys completed throughout the area have identified a wide range of communities present, however the anticipated coverage of those listed as Annex 1 Habitats under the European Habitats Directive, as transposed into UK law by the Conservation (Natural Habitats. &c.) Regulations 1994 (as amended), were diminished or noted as in poor condition.

With the aim of both increasing the Annex 1 Habitats present, particularly those associated with ericoid species including ling heather (*Calluna vulgaris*), cross-leaved heath (*Erica tetralix*), bell heather (*Erica cinerea*), blaeberry (*Vaccinium myrtillus*) and bog myrtle (*Myrica gale*), and recognised as dry and wet heaths, deer fencing of the lower slopes of the survey area has been completed. Livestock use of these lower slopes has been reduced to decrease poaching and impacts to these habitats, with deer similarly excluded as far as possible, thus reducing the over-wintering browsing pressures on ericoid species. This fencing has similarly allowed the planting and establishment of some areas of broadleaved woodland.

1.2 Surveys Aims and Objectives

Previous NVC surveys of the 2017 HIA survey area identified a mosaic of acid / smooth grassland, marshy / tussock grassland, and wet and dry heath habitats to be present. The overarching aim for the study area is to increase the coverage of ericoid species, in particular ling heather, thus increasing the coverage of Annex 1 heath habitats. Exclusion of deer from the lower slopes of the survey area has sought to reduce the primary cause of the reduction in this habitat type, thereby allowing ling heather to re-establish where conditions are suitable. Similarly, where tussock / marshy grassland habitats are present (dominated by purple moor-grass (*Molinia caerulea*)) re-establishment of more damp tolerant species such as bog myrtle and cross-leaved heath is the primary aim. Thus the objectives of the HIA surveys can be summarised as:

- i) assess the levels of current grazing and trampling impacts from herbivores on a representative range of habitats;
- ii) assess the direction of any apparent trends in impact levels; and
- iii) provide a baseline assessment against which changes in impacts can be judged.

The new deer fence acts as a suitable divide to assess the potential improvement in habitat quality through exclusion of deer, with areas above the fence continuing to support a population of deer suited to the surrounding sporting estates' requirements. This area provides a control against which the fenced lower slopes' regeneration can be compared.

2. SURVEY METHODOLOGY

2.1 Methods

Field surveys were completed between 06 and 10 March 2017 by two RPS Ecologists with experience of surveying in the upland environment. The open habitats present were split into two broad types; heathland and grassland as identified from NVC survey data of the area previously collected. Survey points were identified by FCS and provided to RPS. These were ground-truthed during the survey and, if required, could be moved up to 200 m from the initial location to ensure the point represented the correct habitat type. GPS locations of survey points were recorded during the field surveys to ensure these could be relocated if required for future monitoring. Points were further marked by 40 cm long wooden posts. These were situated 2 m to the south of the monitoring 2 x 2 m quadrat to ensure they do not attract herbivores to the monitoring location between monitoring periods.

In addition to the separate habitat types identified across the survey area, locations were further divided depending on their location with respect to the recently erected deer fence. Habitats and associated monitoring locations were thus categorised as fenced or unfenced in order to assess the difference in impact above and below the deer fence line. Sixty survey plots were monitored in each habitat type with 50% falling above the deer fence and 50% below the fence, thus a total of 120 points were assessed during the course of the survey.

Surveys used standard methods for assessing herbivore impacts on upland habitats as outlined by SNH Best Practice Guides¹ and A Guide to Upland Habitats Surveying Land Management Impacts. 2 (MacDonald *et al.*, 1998). The method statement provided by FCS is included for reference in Appendix 1 of this document, including further details of the requirements of the data collection. Readers should refer to this and the Best Practice website for further details of data collection.

With reference to the Macdonald *et al.* (1998) method of data collection, due to the timing of the survey period, not all parameters outlined in the relevant impact and trend assessments for heath, smooth and tussock grassland were applicable. Those assessed are listed below, and readers are referred to the literature for additional detail of their relevant measurements.

Heathland:

- The rate of growth (vigour) of ling heather or blaeberry present;
- The level of browsing of ling heather or blueberry;
- Level of browsing of less palatable species;
- Level of previous winter's browsing of woody material on ling heather;
- The growth form of bog myrtle if present;
- The abundance of uprooted dwarf shrub heath species present;
- The depth of the underlying moss carpet depth if present;
- The level of trampling of bare ground if present;
- The presence of herbivore dung;
- The presence of sheep scars and their erosion status; and
- Heather growth forms and their abundance.

Due to the nature of the habitats and communities known to be present, two separate monitoring methods could be employed to assess impacts to grassland habitats. The parameters of these are detailed below.

¹ <http://www.bestpracticeguides.org.uk/guides/impacts-intro>

Smooth grassland:

- Sward height;
- Uprooting bundles of key tillers present;
- Leaf litter depth;
- Grazing levels of key grass species;
- Presence of feather mosses;
- Grazing of legume species;
- Grazing of mountain avens (*Dryas octopetala*) if present;
- Presence of tree seedlings or saplings;
- Presence of “weedy” species e.g. thistle species (*Cirsium spp.*), soft rush (*Juncus effusus*) and ragwort (*Senecio jacobaea*);
- Coverage of rosette forming species;
- Breakage and uprooting of non-palatable species;
- Levels of weeding of cushion forming species;
- Presence of bare ground; and
- Presence of herbivore dung.

Tussock Grassland

- The principal grazing herbivore;
- Level of grazing;
- Mean inter-tussock sward height;
- Mean accumulated plant-litter height;
- Grazing level of key grass species;
- Grazing of less palatable species;
- Feather moss coverage;
- Presence of tree seedlings or saplings;
- Presence of bare ground; and
- Abundance of rosette forming species.

Finally, to complete the data collection methods summary, a copy of the standardise datasheet used at each location for the survey is supplied in Appendix 2 of this document.

2.2 Limitations

Surveys were completed outside the growing season for many grass species in the upland environment, and as such many of the identifying features of species associated with upland heath and grassland habitats (flowers, seed heads and growth of new shoots and leaves) were not present. Surveys were designed with this in mind, with trend indicators and impact parameters selected to reduce the impact of the timings of the survey on the results gathered. As such, the timings of the survey are not thought to affect the results in terms of its aims and objectives.

No other limitations to completing the assessment were identified.

3. SURVEY RESULTS

As two separate methodologies were used during the assessments (Best Practice and MacDonald *et al.* (1998)) for simplicity these will be analysed in two separate sections. Best Practice methods provide “broad-brush” indicators, whilst the MacDonald method assesses impacts and trends at a finer scale.

3.1 Best Practice Methods Results

The Best Practice methods survey recorded the following parameters across all survey locations, regardless of the habitat type the point fell within; these are:

- Heather presence;
- Trampling;
- Browsing;
- Vegetation height; and
- Presence of deer dung.

Locations for the assessment used a 2 x 2 m quadrat split into sixteen 50 x 50 cm sub-sections (see Appendix 1 for further details). Data collection methods assess parameters and their associated impact as High, Moderate, Low and None; this is reflected in the following section.

3.1.1 Heather Presence

The presence of heather was recorded in each of the 16 sub-sections of the large 2 x 2 m quadrat at each location, regardless of the habitat the quadrat was located in. Plate 1 below summarises the mean heather coverage across all locations by habitat type (grassland or heath) and if above or below the fence line.

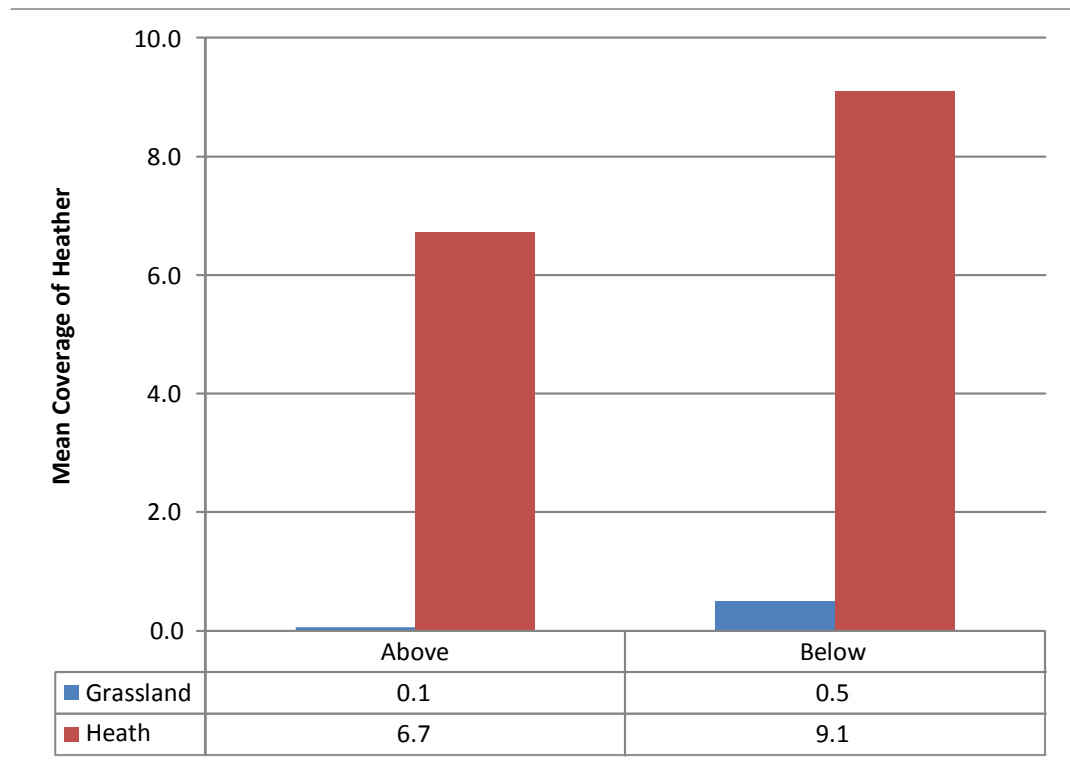


Plate 1 showing the mean number of sub-quadrats (out of 16) with heather present at all location above and below the fence line, and within each broad habitat type.

As is clearly indicated, there is a difference in heather coverage between the differing areas of fence line, particularly within the heath habitats. This trend may or may not be present in the grassland habitats, however currently the difference is too small to be able to draw conclusions from..

3.1.2 Trampling by Herbivores

Plate 2 below summarises the level of trampling and stem breakage recorded through each broad habitat type, and above and below the fence line. A total of 30 locations were visited for each habitat / fence location, thus each score for the impact level is out of 30. The “Not Recorded” category relates to areas where no heather or other ericoid species were present, thus trampling or breakage of such species could not be recorded, but provides for a complete data set.

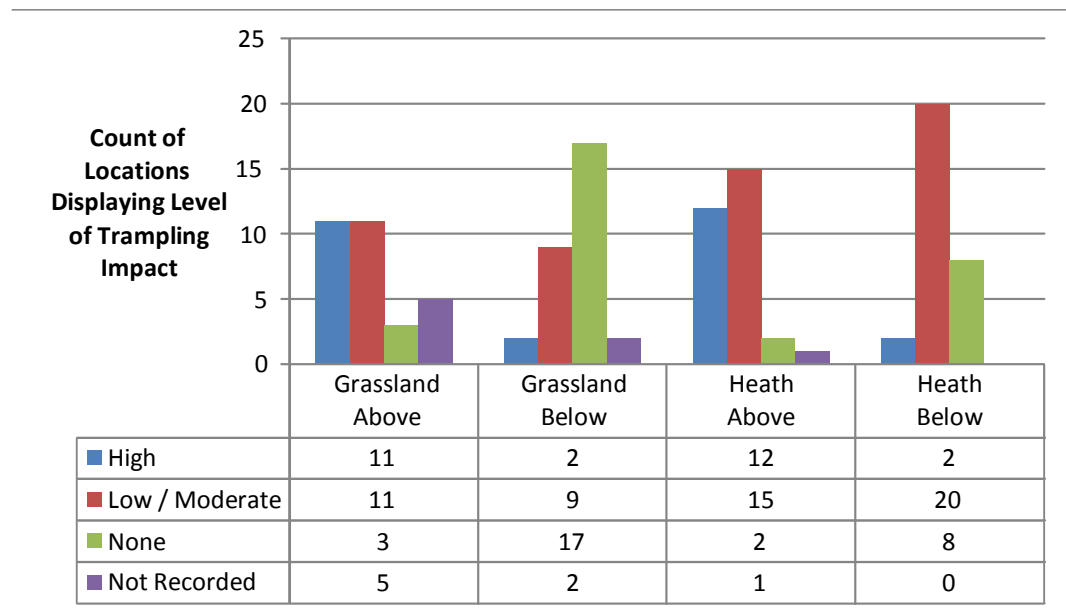


Plate 2 showing trampling and stem breakage impact levels recorded across broad habitat types both above and below the fence line.

The above plate indicates the trend of increased trampling and stem breakage above the fence line for both broad habitat types, as shown by the increased number of locations falling within the “High” category. Across all habitat types there appears to be a continued low / moderate effect from herbivores below the fence line suggesting a continued presence of herbivores remaining in the area.

3.1.3 Browsing Impacts

Plate 3 summarises the levels of browsing recorded across all habitat types both above and below the fence line. Impact levels are out of a possible 150 as five measurements were taken across each 2 x 2 m quadrat.

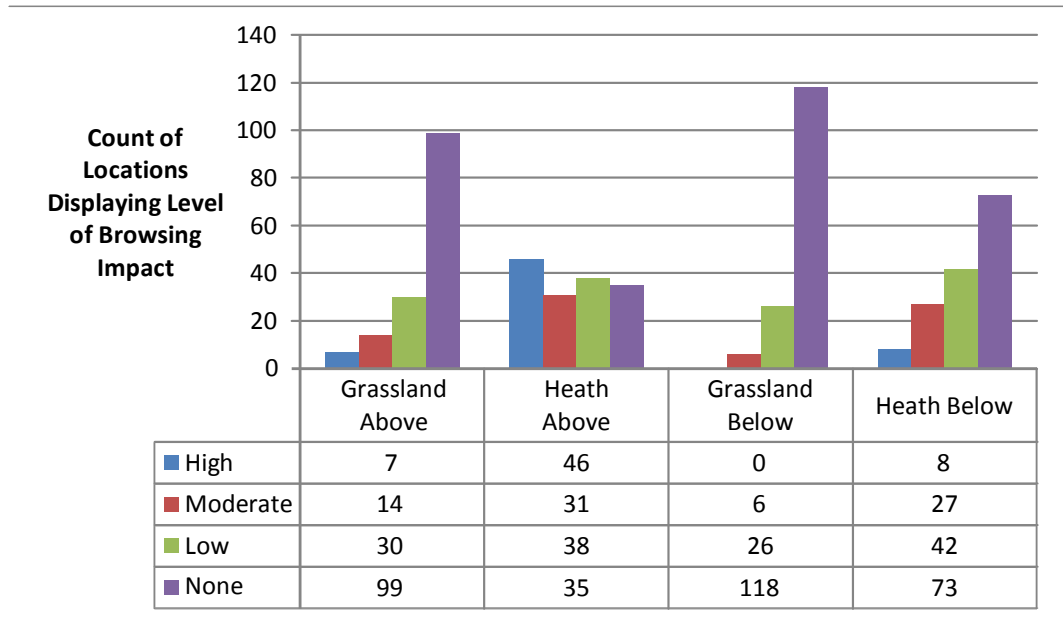


Plate 3 showing browsing impact levels recorded across broad habitat types both above and below the fence line.

The trend depicted in the above plate is that of substantially higher browsing impacts to heath habitats above the fence line. As with other impact indicators such as trampling, there remains a baseline level of impact below the fence line across all habitat types (both moderate and low levels), thus indicating a resident population of herbivores remains in this area.

3.1.4 Vegetation Height

Plate 4 summarises the sward heights of habitat types present above and below the fence line.

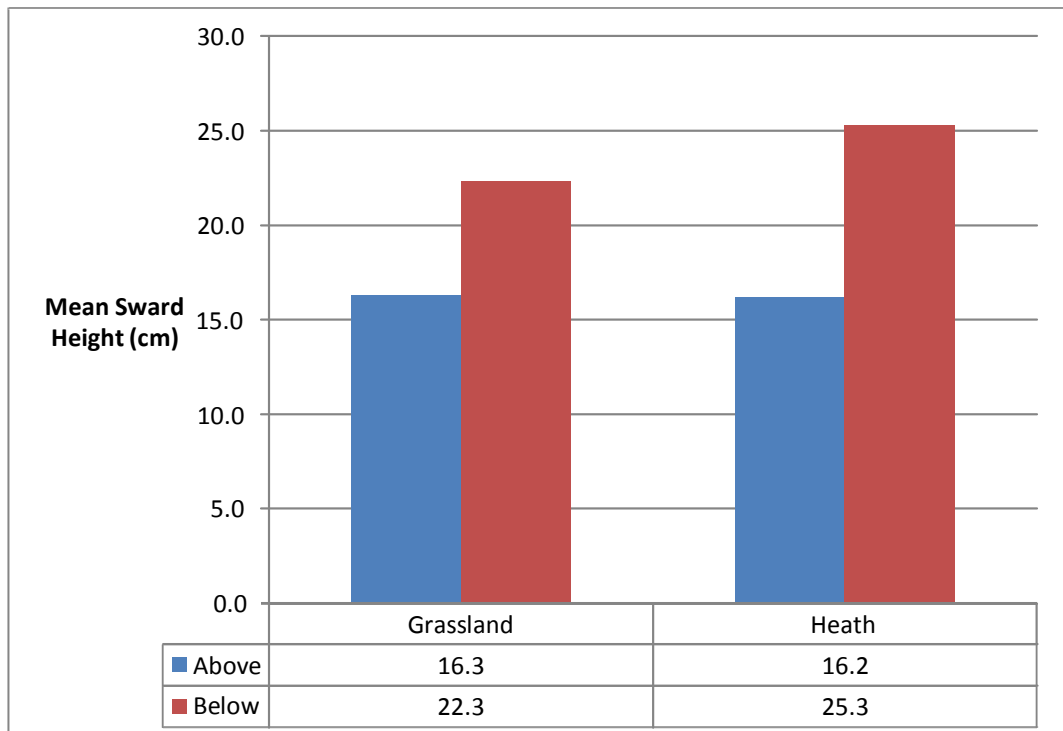


Plate 4 showing mean sward heights for grassland and heath habitats both above and below the fence line.

The above plate clearly shows in increased sward height below the fence line when compared to locations assess above this barrier. This indicates that there is potentially a significant difference in the pressures being exerted on the plants present allowing more vigorous growth to take place within the fenced area where herbivore control is occurring.

3.1.5 Presence of Deer Dung

The following plate summarises the count of herbivore field signs present across both broad habitat types and above and below the fence line.

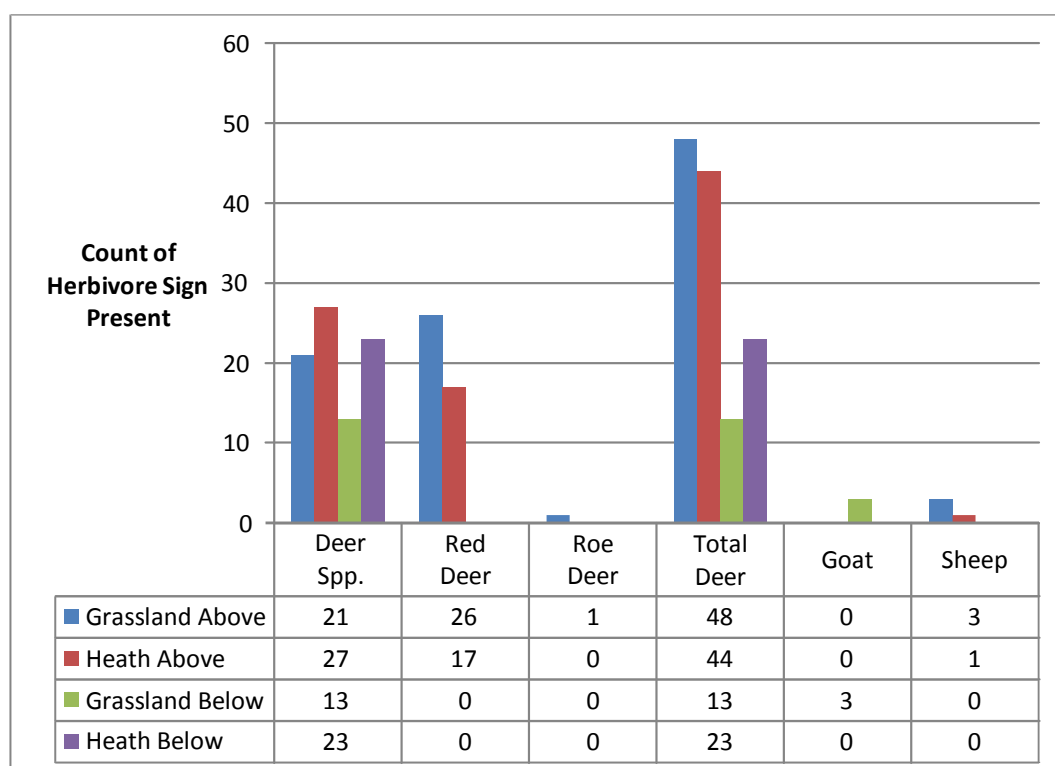


Plate 5 showing count of herbivore field signs recorded across broad habitat types both above and below the fence line.

The trend illustrated by Plate 5 above, is that the majority of herbivore signs recorded across the survey area are attributable to red deer, with only low numbers of signs of sheep and goat recorded. As with other trend indicators illustrated in previous plates, habitats above the fence line depict higher levels of utilisation by herbivores than those below, however there is still a moderate population of deer below the fence line which will continue to impact on the habitats present.

3.2 **MacDonald *et al.* Method**

Data collected using the MacDonald *et al.* (1998) method assessed particular impact and trend indicators dependent on the habitat present at the location; Heathland, Smooth Grassland or Tussock Grassland.

Impact parameters assessed using this methodology are either assigned values of High, Moderate, Low or None, or on a presence / absence scale. Impact levels to determine the value assigned to each parameter are given in the literature and are not listed within this document.

For the purposes of combining the impacts across habitat types to enable an assessment of the differences between areas (above and below the fence line), parameters were assigned corresponding values of 0 – 3 (None – High), or 0/1 for presence / absence

binary data. The values for each location were then summed to highlight those of high impact and those experiencing lesser impacts from herbivores.

3.2.1 Heathland Habitats

Using this method Heathlands were scored out of a possible 25 from the 10 parameters combined in this assessment, with combined impact levels categorised as:

- **Low** – locations scoring a combined impact of less than 5;
- **Moderate** – locations scoring a combined impact of less than 10; and,
- **High** – locations scoring a combined impact of greater than 10.

The above scoring takes into account that a number of the above parameters can score 0, and so will not provide a score if no impact is found.

Plate 6 below summarises the combined impact level for heathland habitats below and above the fence line.

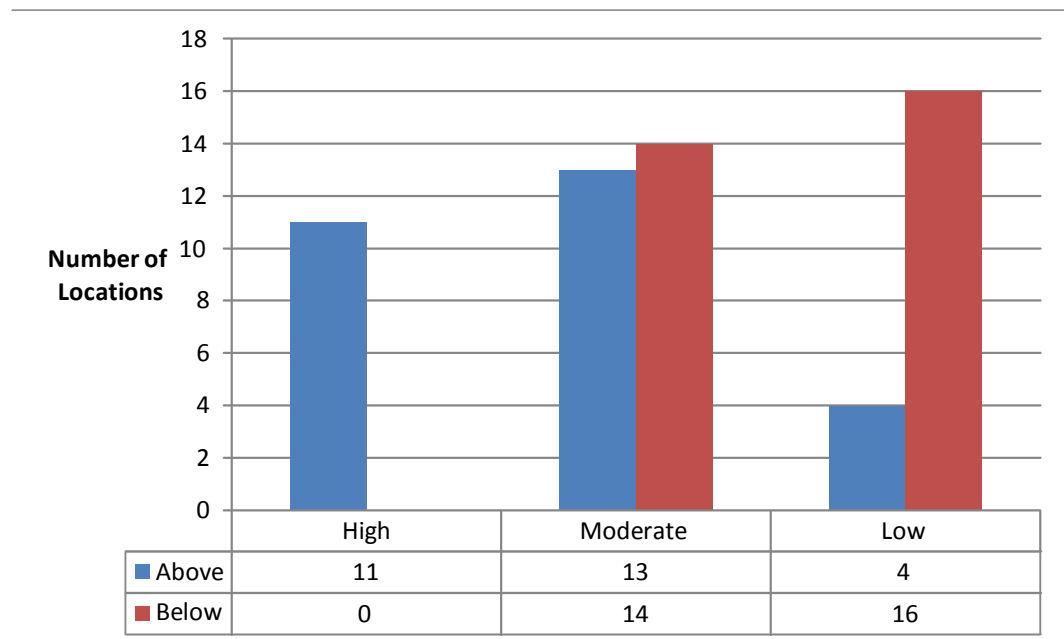


Plate 6 showing the number of locations with the relevant level of combined impact, both above and below the fence line.

The above plate indicates that combined impacts to heathland habitats are significantly raised in locations assessed above the deer fence. Impacts from herbivores are present below the fence line at a continued baseline level, however there are a substantial number of locations below the fence line where impacts are minimal.

3.2.2 Smooth Grassland Habitats

Combined impacts using the above method were scored out of a possible 45 for smooth grassland habitats for the 17 parameters used in this assessment, with combined impact levels categorised as:

- **Low** – locations scoring a combined impact of less than 10;
- **Moderate** – locations scoring a combined impact of less than 20; and
- **High** – locations scoring a combined impact of greater than 20.

Plate 7 below summarises the combined impact level for smooth grassland habitats below and above the fence line.

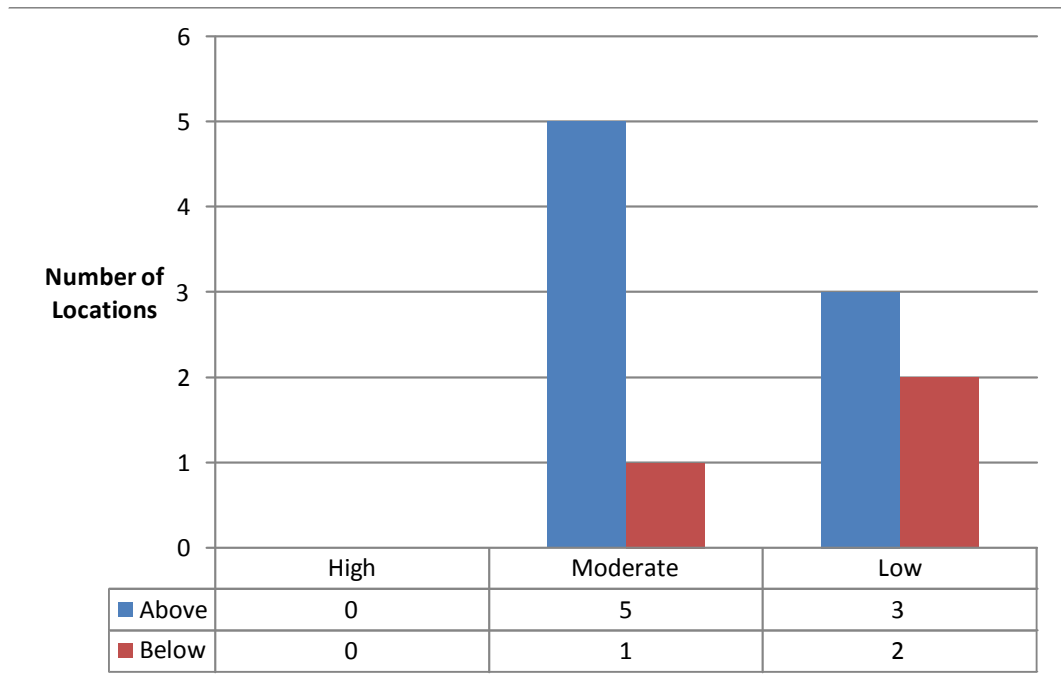


Plate 7 showing the number of locations with the relevant level of combined impact, both above and below the fence line.

The above plate appears to depict the same ongoing trend as other assessments, with increased impacts to areas above the fence line (moderate score of 5 above and 1 below). However, there were limited points located in smooth grassland habitats and so further comment is not possible and the significance of this trend is difficult to ascertain.

3.2.3 Tussock Grassland Habitats

Combined impacts using the above method were scored out of a possible 31 for tussock grassland habitats for the 11 parameters used in this assessment, with combined impact levels categorised as:

- **Low** – locations scoring a combined impact of less than 10;
- **Moderate** – locations scoring a combined impact of less than 20; and
- **High** – locations scoring a combined impact of greater than 20.

Plate 8 below summarise the combined impact level for tussock grassland habitats below and above the fence line.

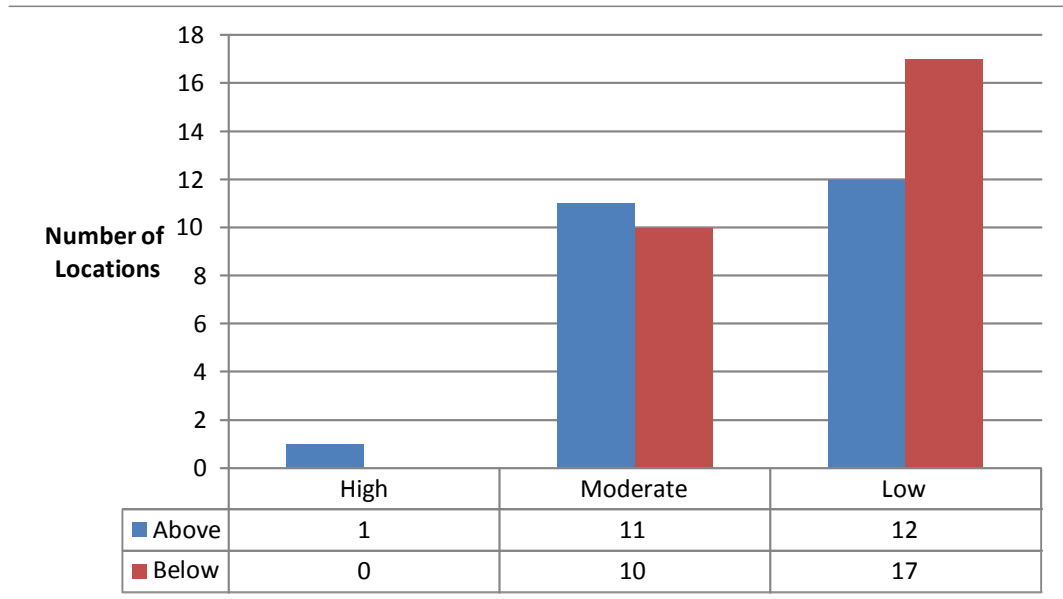


Plate 8 showing the number of locations with the relevant level of combined impact, both above and below the fence line.

From Plate 8, there appears to be a reduced impact level below the fence line to tussock grassland habitats, with a greater proportion of the locations below the fence line assessed as falling within the low impact category.

3.2.4 Overall Combined Herbivore Impacts

Plate 9 summaries both heathland and grassland combined impacts and compares them above and below the fence line to provide an overall assessment of the impacts. Figure 2 provides a visual summary of the locations of combined levels of impacts, which may allow targeted management to be implemented, if practicable.

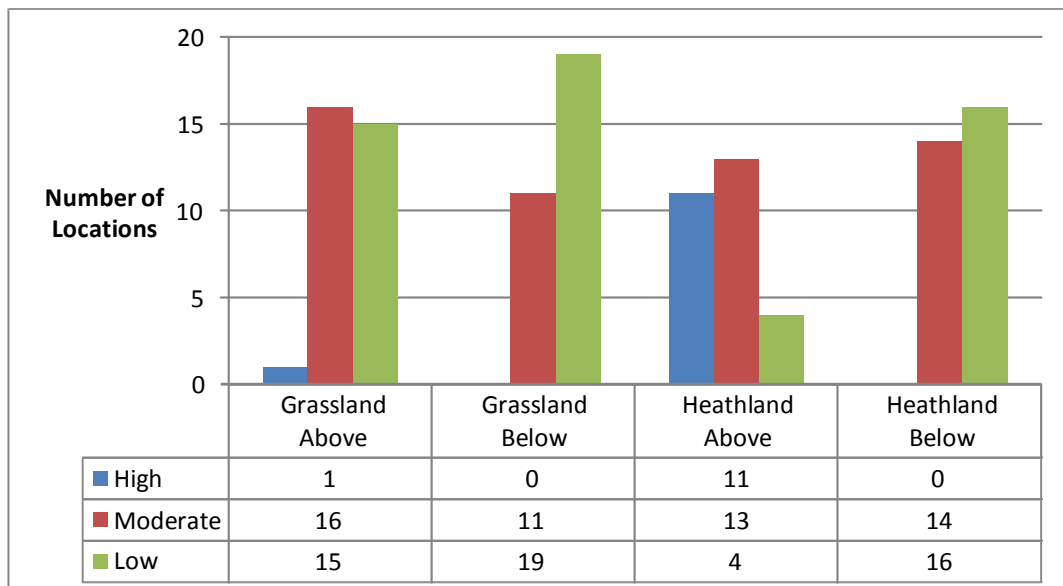


Plate 9 showing the number of locations with the relevant level of overall combined impact, both above and below the fence line.

As can be seen from the above plate, there is a noteworthy difference in the level of impacts occurring to heathland habitat above the fence line when compared to the data for below fence line locations. This trend is not as obvious in the grassland habitats but this is likely attributable to the time of year and grass species not being preferentially

eaten due to the low level of nutrients present in these species during the winter period. Figure 2 shows the location of each monitoring point and the associated combine impacts recorded at the location. In the west of the survey area there is a trend of increased impacts both above and below the fence line, which could provide a basis for targeted management.

3.3 Trend Indicators

Over and above the combined impacts, trend indicators were also assessed to provide further depth of information regarding the impacts currently and historically occurring to habitats across the survey area. Trend indicators monitored were:

Heathland

- Height ratio of heath to grass species within heathland quadrats; and
- Heather growth form and the abundance of these within heathland quadrats.

Tussock Grassland

- Abundance and coverage of rosette forming, creeping or mat-forming herbs species along with species such as heath rush (*Juncus squarrosus*);
- Presence of tree seedlings or saplings; and
- Coverage of feather mosses.

Smooth Grassland

- Abundance and coverage of rosette forming, creeping or mat-forming herbs species along with species such as heath rush; and
- Presence of weedy species such as thistle (*Cirsium spp.*), soft rush (*Juncus effusus*) and ragwort (*Senecio jacobaea*).

3.3.1 **Heath / Grass Height Ratio**

As stated in MacDonald *et al.* (1998) trends in impacts to heathland habitats can be recognised by the ratio of heath species height to the height of grass species, with trends categories as Continuing High, Decreasing or Continuing Low. This ratio has been assessed using the following parameters:

- **Continuing High** – heath species at least 5 cm lower in the sward than grass species;
- **Decreasing** – heath species reasonably similar in height to grass heights – between 5 cm below and 10 cm above; and
- **Continuing Low** – heath species at least 10 cm above the grass sward.

The above categories use mean height values calculated from five random measurements of both heath species and grass species height taken across each 2 x 2 m quadrat.

Plate 10 below summarises the findings of this assessment in relation to locations of the survey points and their proximity to the deer fence; either above or below the fence line.

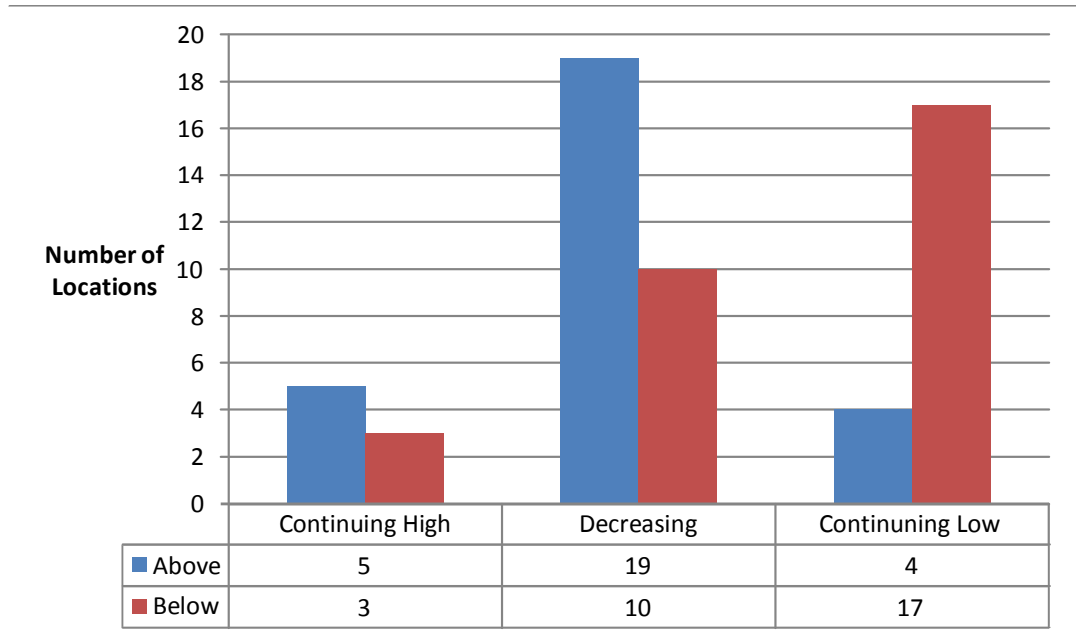


Plate 10 showing the number of locations falling within each impact trend category for heath / grass height ratios, both above and below the fence line.

The above plate clearly shows a trend of continuing low impacts to heathland habitats below the fence line. However, the levels of continuing high impacts are limited both above and below the fence line, with the majority of locations above the fence line appearing to have decreasing impacts to them.

3.3.2 Heather Growth Forms and Their Abundance

Heather growth forms are key indicators of the current and historic impact associated with herbivores and their browsing. The presence of carpet and drumstick forms of heather suggests a continued browsing pressure on heather, with topiary forms suggesting a decrease in these pressures, and natural heather forms indicating a low impact from browsing.

Plate 11 below summarises the heather growth forms found across heath quadrats. A number of quadrats contained no heather, but were classified as heath due to the presence of cross-leaved heath; these were not included within the form assessment. The lack of heather would suggest a high grazing pressure and heather has been preferentially removed from the sward through long-term browsing.

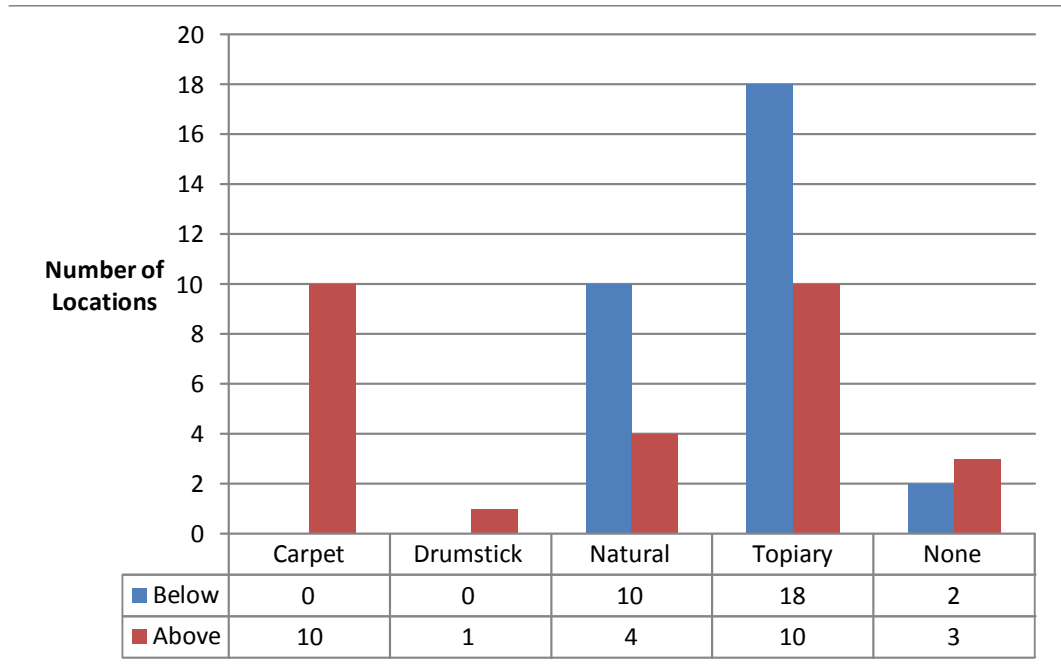


Plate 11 showing the number of locations exhibiting differing heather forms, both above and below the fence line.

The above plate shows impacts to heather to be highest above the fence line, exhibited by a high proportion of quadrats containing carpet or drumstick heather forms; these forms are absent from quadrats below the fence line. Similarly, natural heather growth forms and topiary browsing were significantly more abundant below the fence line.

3.3.3

Abundance and Coverage of Rosette Forming Species in Tussock Grassland

Plate 12 below summarises the trends associated with the coverage of rosette forming species as either Continuing High, Decreasing or Continuing Low as determined by the parameters stated within MacDonald *et al.* (1998).

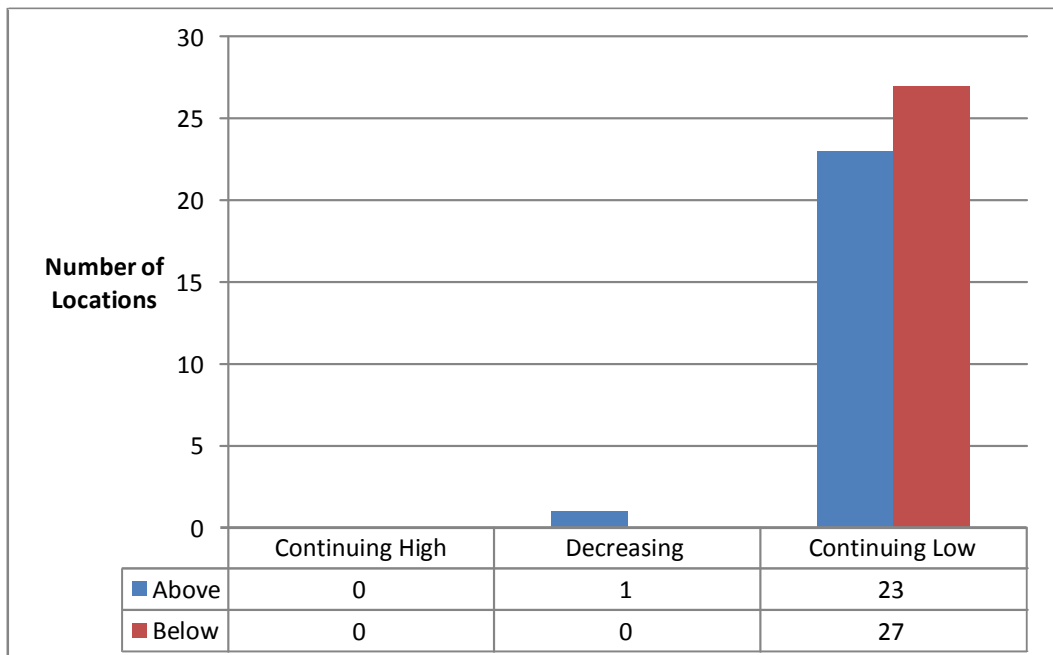


Plate 12 showing the number of locations exhibiting differing impact trends based on the presence of rosette forming species, both above and below the fence line.

Plate 12 indicates no difference in the abundance or coverage of rosette forming species between locations above and below the fence line. The trend impact indicates that there is a continuing low impact at all (bar one) location if measured by this parameter, however this may just be a fact that there is currently no seed source for the relevant species.

3.3.4 **Presence of Seedlings or Saplings in Tussock Grassland**

Within tussock grassland habitats, 3/24 locations above the fence line were found to have seedlings or saplings within 10 m of the location, with 10/27 locations below the fence line being in close proximity to seedlings or saplings. In an ideal scenario the trend of herbivore pressures would use inter-tussock sward height to determine these levels with the presence of trees, however given the time of year the surveys were completed and the minimal growth of this sward, this would not give a reliable indication of current trends. However, ongoing monitoring of the number of seedlings or saplings present in proximity to the sample location (if monitoring is undertaken in the same month in subsequent years), will give a reliable indication of the trend of browsing pressures exhibited across the survey area.

3.3.5 **Coverage / Abundance of Feather Mosses in Tussock Grassland**

Feather moss abundance is affected by the levels of trampling by herbivores, with increased herbivore presence, and therefore increased trampling impacts, reducing the coverage of feather moss species beneath the grass sward. Plate 13 below summarises the trends of herbivore impacts assessed via feather moss coverage within the tussock grassland locations, as per MacDonald *et al.* (1998) parameters.

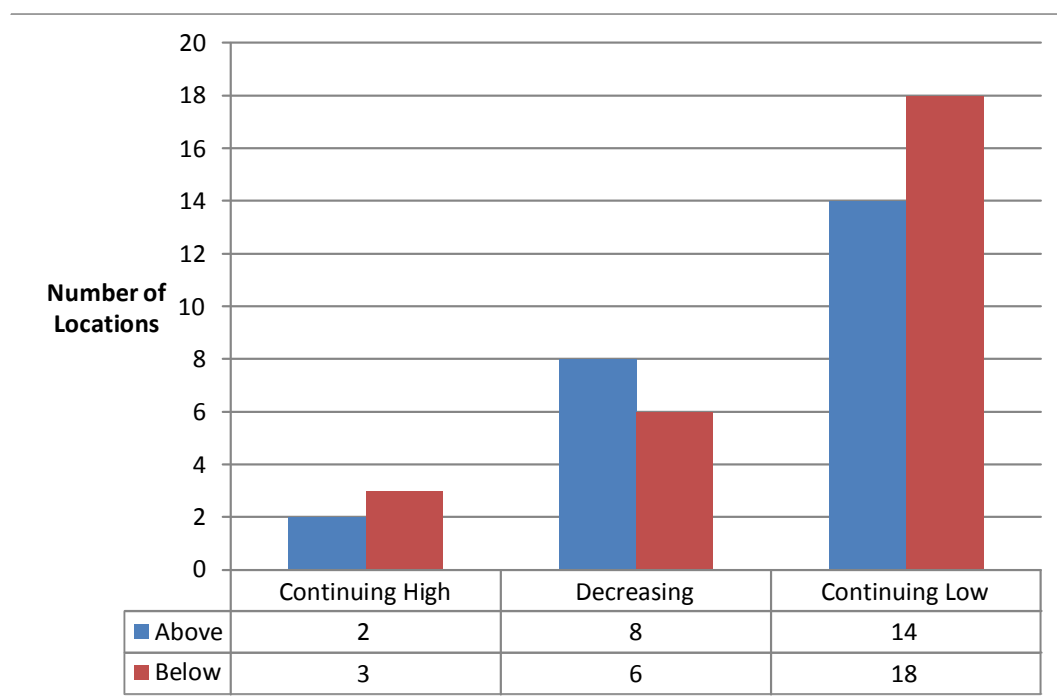


Plate 13 showing the number of locations exhibiting differing impact trends assessed by the coverage / abundance of feather moss species, both above and below the fence line.

The trends shown in Plate 13 above indicate that with regards to effects from herbivores and trampling in areas of tussock grassland, these are predominately either low or decreasing towards this level.

3.3.6 **Abundance and Coverage of Rosette Forming Species in Smooth Grassland**

As with the coverage of feather mosses in tussock grassland habitats, coverage and abundance of rosette forming species in smooth grassland is a product of heavy

trampling / poaching by herbivores, along with the associated grazing by such species. The opening of the tightly knit sward allows the colonisation of such species, thus it is a good indicators of impact trends.

Plate 14 below summarises the conspicuous nature of the presence or absence of such species, and thus if impacts to the associated location by herbivores are light or heavy.

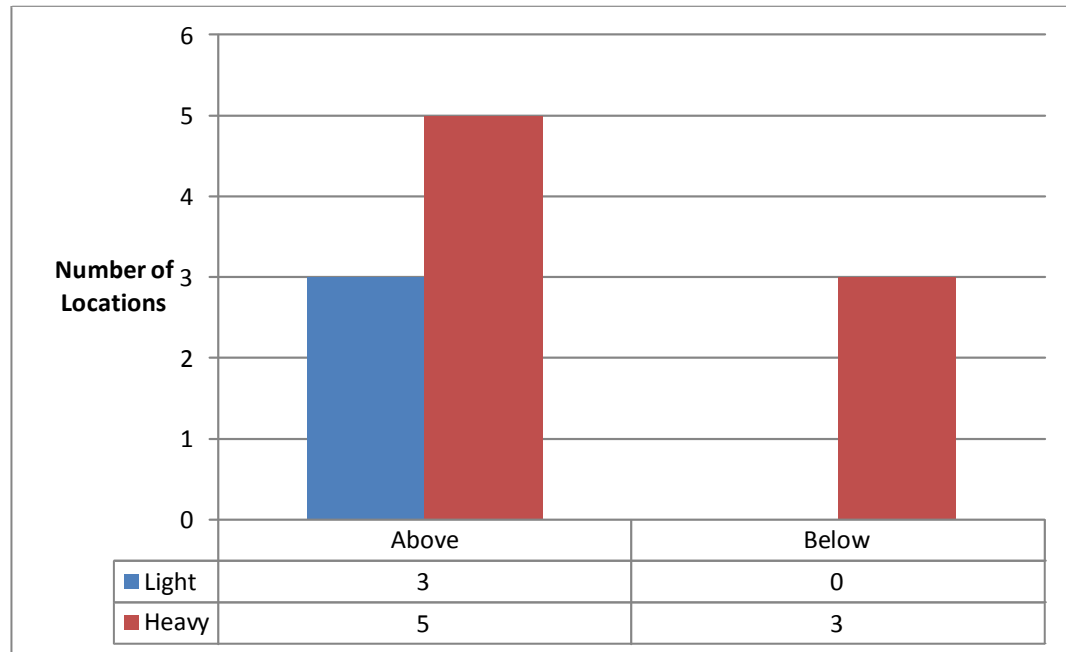


Plate 14 showing the number of locations exhibiting differing impact trends assessed by the coverage / abundance of rosette forming species, both above and below the fence line.

The trend indicated by the above figure is that trampling and the abundance of species associated with this action is likely greatest above the fence line, although due to the small sample size in this habitat type, additional monitoring is required to verify this.

3.3.7 Presence of Weedy Species in Smooth Grassland

As with rosette forming species, the increased presence of weedy species such as thistles, ragwort and soft rush, act as an indicator of high herbivore pressure within an area. Plate 15 below summarises the presence or absence of such species from the locations assessed in smooth grassland habitats.

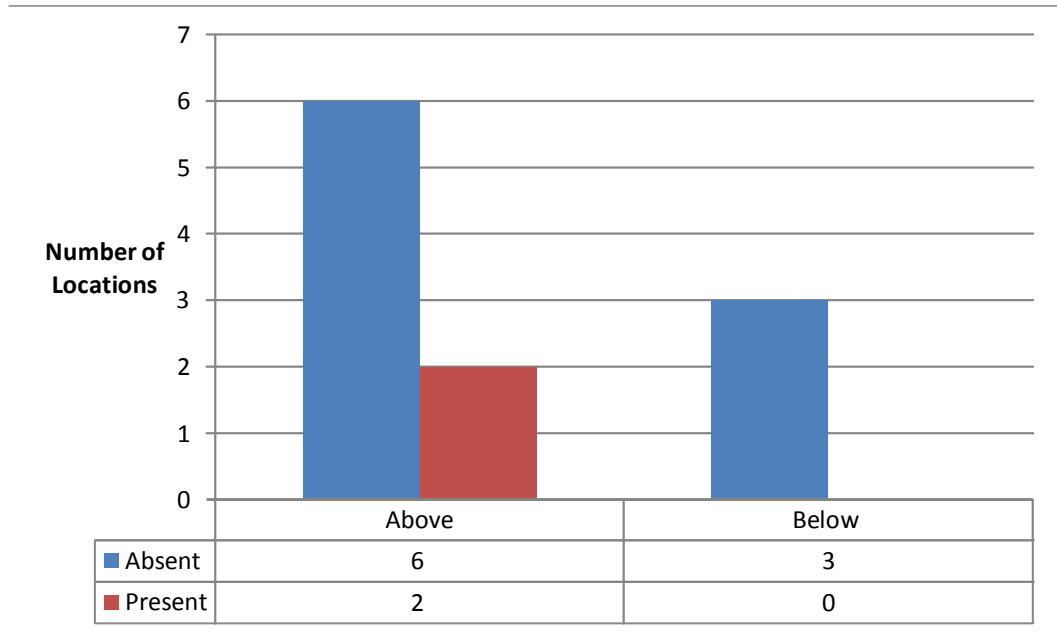


Plate 15 showing the number of locations exhibiting differing impact trends assessed by the coverage / abundance of “weedy” species, both above and below the fence line.

As shown by the above plate, only two of the 11 locations assessed during field work contained weedy species. This would suggest low impacts from herbivores, however these results should be caveated by the low sample size and the fact that the survey was undertaken out with the growing season for these species – many of which are perennial and die back over winter months.

4. DISCUSSION, CONCLUSION AND RECOMMENDATIONS

4.1 Discussion

4.1.1 Impact Assessment

The above results section aims to summarise the findings of the surveys and the multiple parameters assessed across heath and grassland habitats, both above and below the deer fence line. In doing so, this allows an assessment of the current impacts and their trends to be made, which will in turn inform management decisions concerning the survey area and surrounding landscape.

Heather coverage was assessed across all 120 locations with results showing heather significantly reduced in heathland habitats located above the deer fence. Heather abundance / coverage between grassland locations above and below the deer fence showed little difference, however this is likely due to the limited abundance of the species in this habitat type by which any noticeable difference could be detected.

As with heather coverage, trampling of habitats was highest across locations above the deer fence line. This was evident in both grassland and heathland habitats, suggesting a higher presence of herbivores across the unfenced areas. These results were backed up by the presence of herbivore signs (predominately dung) which indicated a higher presence of deer above the fence line than below. However, within both of these sets of results, there was an underlying moderate impact across all areas and a moderate presence of herbivores recorded across all monitoring locations; thus suggesting that a higher than anticipated population of deer still exists within fenced locations.

Browsing impacts from herbivores across the survey area mirrored the trends indicated through signs of trampling and of herbivore presence, with areas above the fence line exhibiting the highest levels of browsing, in particular within heathland habitats. However, an underlying moderate impact was recorded across all habitat and location types. This similarly corroborates with the assessment of a higher than anticipated deer population below the fence line.

Corroborating with the above assessment completed using the SNH Best Practice Methods, herbivore impact assessments to heath, tussock and smooth grassland habitats completed using the MacDonald *et al.* (1998) methods show high levels of herbivore impacts to heathland habitats, with an underlying moderate impact across the all habitat and location types. Figure 2 summarises these results, and indicates a trend of greater impacts to all habitats and locations at the west end of the survey area; this may allow specific targeted management of herbivores to reduce these impacts.

4.1.2 Trend Indicators

Through the use of the MacDonald *et al.* methods, a number of trend indicators were recorded with the aim of quantifying the impacts noted through both methods (as discussed above) and identifying where these were continuing to remain high, decrease or remaining at a low level.

Impacts to heathland habitats and the species (in particular ling heather) from current and historical browsing mirrored the trends indicated above, namely impacts were highest above the fence line but with an underlying impact continuing below. This was shown through the abundance of carpet forms of heather, however with topiary forms still remaining both above and below the fence line in equal measure. The decreasing trend of browsing below the fence line is clearly shown by the number of locations exhibiting

natural growth forms, whereas no location containing this growth form were recorded above the fence line. This would suggest a decreasing trend of impacts below and a continuing high trend above the fence line with regards to herbivore impacts to heathland habitats.

Heather to grass height ratios are similarly used as an indicator of herbivore impacts with greater ericoid heights above the grass sward indicating low browsing pressures from herbivores. Taking the results summarised within Plate 10 for the trends occurring both above and below the fence line, impacts below the fence line are either continuing to remain low or are decreasing; this mirrors the trend indicated by the heather growth forms recorded. Above the fence line, in few areas were trends recorded as continuously low (as one would expect from the other results discussed above), however the majority of locations (19/28) indicated a decreasing impact on heathland habitats, with only 5/28 locations continuing to exhibit a ratio of heather to grass indicating continuing high trends. These results are more promising than some of the others above would suggest, but this must be caveated by the fact that the survey was undertaken at the very start of the growing season for grass species. This in turn would reduce grass heights recorded below those mid-growing season – this could artificially improve the trend indicators toward indicating lower herbivore pressures than are actually present.

Grassland trend indicators for both smooth and tussock grasslands indicate decreasing or continuing low levels of impacts through the presence of weedy species, rosette forming species and the abundance of feather mosses within the grassland swards. However, as with the trend indicator of heath to grass ratios (discussed in the paragraph above), it should be caveated that these surveys were undertaken outwith or at the start of the growing season, and as such these indicators may be depressed from levels which might be recorded mid-season. Similarly, the low numbers of smooth grassland locations assessed during the survey makes recognising trends associated within these habitats difficult to ascertain, and if future monitoring is undertaken consideration should be given to increasing the number of locations situated in this habitat sub-category. It should also be noted that with regards to grassland habitats, that during the winter season (the period which the assessment of trends will be capturing), heathlands are preferentially utilised by herbivores, with woody species browsed due to the lack of nutritional growth by grasses. This may similarly artificially decrease impacts and their associated trends recorded across grassland habitats.

4.2 Conclusions and Recommendations

To conclude, the results of the Loch Katrine Habitat Impact Assessment survey indicate a trend of high herbivore pressure to heathland habitats above the deer fence line, with continuing moderate / decreasing to low pressure below the fence line. The results indicate that a population of deer still exists, albeit at suppressed levels as a result of stalking activities below the fence line which is reducing the impact of herbivores on ling heather and heath species in general, along with allowing a degree of natural regeneration by tree species.

Trends and impacts to grassland habitats appear to be lower than those to heathland habitats; however this may be in part due to the timings of the surveys and the seasonal utilisation of habitats. However, ongoing monitoring of grassland habitats and the coverage / regeneration of heath species at these locations will be important in determining if the long term aims of expansion of heath habitats is succeeding.

In conjunction with continuing to monitor the impacts of herbivores to the habitats present at each of the 120 locations on a regular basis, comparing the results of the monitoring to deer population survey results would provide additional information on the pressures from herbivore utilisation. Similarly, completing a large scale Effective Deer Utilisation survey to look at over-wintering land use by deer species may be an additional effective survey to provide specific data with regards to herbivores, their use of the Loch Katrine area, their impacts to key habitats, and the ongoing management required to meet the aims and objectives of the land in the medium- to long-term.

FIGURES

List of Figures:

Figure 1 – Loch Katrine Habitat Impact Assessment Survey Area

Figure 2 – Loch Katrine Habitat Impact Assessment Combined Survey Results

APPENDIX 1 – FORESTRY COMMISSION SCOTLAND SUPPLIED METHOD STATEMENT AND REQUIREMENTS

Methods

The map attached indicates the overall site boundary and two different broad habitat types present. Sample plots have been chosen initially by random sampling of National Vegetation Classification (NVC) communities and mosaics containing the selected habitat types generated using Geographic Information System (GIS). At each randomly-selected locality, one suitable NVC community is present within 200m of the randomly selected point, the surveyor will make a decision about which community to place the monitoring point in. A new Geographic GPS location will be recorded for each sample plot to ensure accurate recording.

Plots will not be marked on the ground as accurate GPS references should ensure that repeat surveys can be carried out in the future. Digital photographs will be taken of each impact assessment sample plot to illustrate the impact categories together with a context photograph to assist relocation.

Dwarf shrub heath
Blanket bog, Tall herbs, Springs

Minimum of 30 random plots per habitat area, inside and outside fenced enclosures.

Each plot marked by a small wooden post, tagged and located by photograph and GPS. A post can increase impacts as they may be used by herbivores for scratching; to avoid this posts will be located 2m north of the sample location.

Each plot 2 x 2 m subdivided into sixteen 0.5 x 0.5m quadrats.

bearing recorded

At each sample plot location the appropriate small-scale grazing and trampling indicators given in herbivore impacts on upland habitats should be recorded. Impacts should be recorded on a three (Low, Moderate, High) scale depending on the options available. Indicators that are not present or not applicable should be recorded as NP or NA or as uninformative U. It is a recognised part of the methodology that not all indicators will be applicable at every individual sample location. The appropriate trend indicators should be used to assess long-term trends in impact levels. Note should also be 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). Trampling impacts attributable to recreation should be recorded using target notes where encountered during the course of the other assessments. Observations of herbivore dung (attributed to species where possible) will be important in assessing the relative contribution of different grazers to the impacts observed. Note should also be made of any other factors which may assist in interpreting the impacts, such as topography (exposed versus sheltered locations) or the existence of a through-route from one preferred habitat type to another.

Condition measures

In addition to the assessment of impacts and trends, measures of habitat condition should also be recorded for each of the habitats to be assessed. Many of these assess essentially the same indicators as those used in the impact assessment, but are recorded in a more quantitative way. The indicators selected are those regarded as the most reliable indicators of habitat condition and will be used to monitor changes in habitat condition over time.

Dwarf shrub heath - What to measure	How to analyse
<p>For browsing look at three or four handfuls of ling heather within each of quadrats 1, 4, 10, 13 and 16 as shown in the diagram in BPG Habitat Impact Assessment: Principles in Practice. If ling not present then use blaeberry. Look at the browsing on the long shoots and classify as:</p> <ul style="list-style-type: none"> • LIGHT: less than 33% of long shoots in the sample browsed • MODERATE: 33 – 66% long shoots browsed • HEAVY: greater than 66% long shoots browsed 	<p>For each plot, summarise the frequency of quadrats in each class (for example: 3/5 quadrats “LIGHT”; 2/5 quadrats “MODERATE”; 0/5 quadrats “HEAVY” browsing.</p> <p>In this example, the plot would be described as having “LIGHT” browsing as this was the class with the highest frequency.</p> <p>For each site, summarise the frequency of plots in each class (for example, in a site with 30 plots: 25/30 plots “LIGHT”; 3/30 plots “MODERATE”; 2/30 plots “HEAVY” browsing.</p>
<p>For trampling, if plots are > 50 m away from a supplementary feeding site, assess the amount of heather stem breakage as a result of trampling and assign as classes for the whole plot:</p> <ul style="list-style-type: none"> • LIGHT / MODERATE: inconspicuous • HEAVY: conspicuous. 	<p>For each site, summarise the frequency of plots in each class (for example, in a site with 30 plots, 14/30 plots “LIGHT/ MODERATE”, 16/30 plots “HEAVY” heather stem breakage.</p>
<p>For heather distribution record presence or absence of heather (or blaeberry) within each of the 16 quadrats.</p>	<p>For each plot, summarise the frequency of quadrats with presence or absence of heather (or blaeberry) (for example: 5/16 quadrats, heather PRESENT; 11/16 quadrats, heather ABSENT).</p> <p>For each site, summarise the frequency of quadrats with heather (or blaeberry) present or absent (for example, in a site with 10 plots (a total of 10 x 16 quadrats): 60/160 quadrats, heather PRESENT; 100/160 quadrats, heather ABSENT).</p>

<p>For vegetation height take three or four measurements with a tape measure within each of quadrats 1, 4, 10, 13 and 16.</p>	<p>For each plot average the height of the vegetation</p> <p>Average the vegetation height for all plots.</p>
<p>Record presence of deer dung in each plot.</p>	<p>For each site, summarise the frequency of quadrats with deer dung present or absent. For example, in a site with 10 plots: 80/160 quadrats deer dung PRESENT; 80/160 quadrats, deer dung ABSENT.</p>
<p>Take digital photo of whole plot from fixed point</p>	<p>Will enable detection of changes in heather distribution over time.</p>
<p>Herbivore species present</p>	<p>Record which herbivore species are present and whether impacts are clearly attributable to one or more species.</p>

Grassland – Tussock and What to measure	How to analyse
<p>For browsing in Tussock grasses look at 3 or 4 handfuls of <i>Nardus stricta</i> tussocks within each of quadrats 1, 4, 10, 13 and 16 as shown in the diagram in BPG Habitat Impact Assessment: Principles in Practice. If <i>Nardus</i> not present then use 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, blaeberry, 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.</p> <p>For browsing in Smooth Grassland look at 3 or 4 handfuls of 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>. On legume species (e.g. <i>Lotus coniculatus</i>, <i>Lathyrus linifoliusm</i> <i>Trifolium repens</i>) or <i>Plantago lanceolate</i>. 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. 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. Breakage and uprooting of shoots of <i>Silene aculism</i> <i>Minuartina sedoides</i>, <i>Huperzia selago</i>, <i>Saxifraga hypnoides</i>, <i>Selaginella selaginoides</i>. Cover of mosses, particularly “feather” mosses such as <i>Phytidelphus squarrosus</i>, <i>Pleurozium scheberi</i>, <i>Pseudoscleropodium purum</i>, <i>Hypnum cupressiforme</i> and <i>Hylocomium splendens</i>.</p> <p>Look at the browsing on the shoots and classify as:</p> <ul style="list-style-type: none"> • LIGHT: less than 33% of the sample browsed • MODERATE: 33 – 66% sample browsed • HEAVY: greater than 66% sample browsed 	<p>For each plot, record percentage of leaves browsed from the 3 or 4 handfuls within the plot. summarise the frequency of quadrats in each class (for example: 3/5 quadrats “LIGHT”; 2/5 quadrats “MODERATE”; 0/5 quadrats “HEAVY” browsing.</p> <p>In this example, the plot would be described as having “LIGHT” browsing as this was the class with the highest frequency.</p> <p>For each site, summarise the frequency of plots in each class (for example, in a site with 30 plots: 25/30 plots “LIGHT”; 3/30 plots “MODERATE”; 2/30 plots “HEAVY” browsing.</p>

<p>For trampling, if plots are > 50 m away from a supplementary feeding site, assess the amount of stem breakage as a result of trampling and assign as classes for the whole plot:</p> <ul style="list-style-type: none"> • LIGHT / MODERATE: inconspicuous • HEAVY: conspicuous. 	<p>For each site, summarise the frequency of plots in each class (for example, in a site with 30 plots, 14/30 plots "LIGHT/MODERATE", 16/30 plots "HEAVY" heather stem breakage.</p>
<p>For heather distribution record presence or absence of heather (or blaeberry) within each of the 16 quadrats.</p>	<p>For each plot, summarise the frequency of quadrats with presence or absence of heather (or blaeberry) (for example: 5/16 quadrats, heather PRESENT; 11/16 quadrats, heather ABSENT).</p> <p>For each site, summarise the frequency of quadrats with heather (or blaeberry) present or absent (for example, in a site with 10 plots (a total of 10 x 16 quadrats): 60/160 quadrats, heather PRESENT; 100/160 quadrats, heather ABSENT).</p>
<p>For vegetation height take three or four measurements with a tape measure within each of quadrats 1, 4, 10, 13 and 16.</p>	<p>For each plot average the height of the vegetation</p> <p>Average the vegetation height for all plots.</p>
<p>Record presence of deer dung in each plot.</p>	<p>For each site, summarise the frequency of quadrats with deer dung present or absent. For example, in a site with 10 plots: 80/160 quadrats deer dung PRESENT; 80/160 quadrats, deer dung ABSENT.</p>
<p>Take digital photo of whole plot from fixed point</p>	<p>Will enable detection of changes in heather distribution over time.</p>

Herbivore species present

Record which herbivore species are present and whether impacts are clearly attributable to one or more species.

