

# NatureScot Research Report 1282 - Ardvar Woodlands SSSI/ SAC Herbivore Impact Assessment 2021

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## **Keywords**

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Ardvar; woodland; deer browsing; regeneration; plots; assessment; herbivore; impacts.

## **Background**

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Haycock and Jay Associates Ltd was commissioned by NatureScot to undertake an Assessment of Herbivore Impacts at Ardvar Woodlands SSSI/SAC in May 2021.

This assessment aims to repeat the survey of 2018 to determine the current herbivore impacts in each of the properties across Ardvar SSSI/SAC.

## **Main findings**

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- Over the whole of Ardvar woodland the most frequent current herbivore impact level is Medium (46% of plots), however, high impact levels are recorded in 26% of plots.
- For 48% of plots the mean height of the ten nearest seedlings to the centre of each survey plot is 10cm or less. For 39% of plots the mean height of the ten nearest seedlings is between 11-50cm.
- Sheep are present on the Quinag and Kylesku Estates north of the B869 and are adding to the browsing level in this area. In the rest of the woodland areas all other recorded signs of herbivore activity indicate that red deer are the main herbivore within Ardvar woodland.
- Deer fenced exclosures recorded low to no herbivore impacts.
- The creation of the large exclosure on the North Assynt Estate may have pushed deer that were using this area into other woodland areas.
- Seedling and sapling stocking density was calculated; however, no comparison is made with the survey of 2016 due to the differences in the time of year that the surveys took place. The 2021 survey for stocking density should be considered a baseline to compare against future surveys, as the survey was not part of the 2018 HIA.
- To aid seedling and sapling establishment, particularly for preferentially browsed tree species such as, rowan, hazel, and holly, the browsing impact levels need to be reduced across the whole of the woodland. A target for a significant percentage of plots outside of exclosures to have low impacts, and for the overall impact level to be no more than medium, is suggested.

## Acknowledgements

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## Abbreviations

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Deer Management Group (DMG)  
Herbivore Impact Assessment (HIA)  
Special Area of Conservation (SAC)  
Site Condition Monitoring (SCM)  
Site of Special Scientific Interest (SSSI)

## Introduction

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Haycock and Jay Associates Ltd was commissioned by NatureScot to undertake an Assessment of Herbivore Impacts at Ardvar Woodlands Site of Special Scientific Interest (SSSI) / Special Area of Conservation (SAC) in May 2021.

The woodland Herbivore Impact Assessment (HIA) is required to provide an assessment of the current herbivore browsing levels. This will allow NatureScot and land managers to monitor progress towards achieving favourable condition.

This report details the methodology, results, analysis and conclusions of an HIA carried out in May 2021. The results of the 2021 survey are compared with the survey results from 2018. The general prognosis for the woodland is also discussed.

Ardvar woodlands are located on the northwest coast of Scotland between Drumbeg and Unapool in Sutherland. The woodland mainly falls within the Ardvar woodland SSSI, part of Ardvar and Loch a' Mhuilinn Woodlands SAC, along with smaller areas of woodland contiguous with the SSSI to the south and west of Loch Ardbhair.

Ardvar woodland is birch dominated and is split into three main areas: 1 Nedd/ Gleann Leireag; 2 Loch Ardbhair, Gleann Ardbhair and Clais Ardbhair; and 3 Kerrachar to Unapool. There is also a small area of woodland on a steep gorge at Creag an Spardain. These woodlands are a relic of what would have once been more extensive forests of northwest Scotland and are of high conservation value. The woodland falls within four different management units; the North Assynt Estate, the Ardvar Estate, the Reintraid Estate and the Quinag Estate (JMT). In the 2018 report the assessment of data for Reintraid Estate was included as part of the Ardvar Estate data, however the estate now has new ownership and so the data is presented separately.

There has been a long history of farm animals grazing within the woodlands, however sheep were removed from the Ardvar estate in the 1970s and the main herbivore of the woodlands is now red deer. Sheep grazing rights are currently being exercised on areas

of the Quinag and Kylesku Estates.

Deer fenced enclosures have been established in areas of the Ardvar Estate and North Assynt Estate and efforts have been made to reduce deer occupancy within the woodland to a level that would allow recovery of the woodland habitat.

## Methodology

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The total survey area was 620ha, which includes all of the existing woodland within the SSSI, a 50m buffer zone around the existing woodland stands, and woodland outside of the designated area but within a wider woodland network.

The survey was carried out in the May allowing the survey to take place at the optimal time of year for woodland herbivore impact assessment (Armstrong *et al.*, 2014).

This enables the survey to assess the browsing impacts that occurred during the winter months on the previous year's growth. Impacts on the current season's spring growth were also recorded.

The plots surveyed were the same as those surveyed in 2018 and follow the arrangement of plots used in Woodland Profile Surveys which is based on Forestry Commission Information Note 45 (Kerr *et al.*, 2002).

The number of plots surveyed was 122. The plots were 25m in radius (0.2ha) meaning that the area surveyed was 3.9% of the total woodland area.

Since the 2018 monitoring a new enclosure has been put in place on the North Assynt Estate, which contains 16 plots. Any signs of herbivore presence were also recorded whilst navigating between plots.

During monitoring in 2016 each plot centre was marked with a wooden peg. For the 2021 HIA each of these plots was relocated. The following attributes were measured and recorded within the plot:

- The 10-figure grid reference of the wooden peg at the centre of the plot, if the grid reference was different to that supplied.
- The current herbivore impacts were assessed using the indicators Seedlings and Saplings, and Preferentially Browsed Species taken from the FCS Woodland Grazing Toolbox (WGT) for herbivore impacts.
- The height of the ten nearest seedlings and saplings to the centre of the plot. The measurement was based on the regeneration visible above the surrounding vegetation, also recording the distance from the centre of the plot, and direction as a compass bearing. Where the seedling was below the height of the field layer, the height was recorded as zero. It should be noted that these seedlings are not necessarily the same individuals as in the 2018 survey, they are just the ten nearest seedlings at the time of the 2021 survey.

- The plot vegetation height based on an average of 5 measurements taken in a 'W' formation across the plot.
- The predominant habitat type or habitat mosaic.
- The presence of factors other than browsing that may be limiting natural regeneration (e.g. shade, water-logging, drought, areas of dense bracken cover, exposed rock, altitude or exposure, deep and/or continuous bryophyte layer, dense field layer, distance from seed source).
- Other obvious signs of herbivore presence.
- Plot photos taken from the southern edge facing north as standard, with any variations from this recorded.

The following data was collected at the 12.6m radius plot size, for insight into tree species abundance and diversity according to Life Class:

- Number of seedlings and saplings of each species present within each Life Class (i.e. small seedling (seedling below the height of dominant field layer), large seedling (Established seedling up to 1.3 metres in height), small sapling (Saplings  $\geq 1.3\text{m}$   $< 3\text{m}$  tall and  $< 7\text{cm}$  DBH), large sapling (Saplings  $\geq 3\text{m}$   $\leq 5\text{m}$  tall and  $< 7\text{cm}$  DBH)).
- Number seedlings and saplings of each species with browsing damage.
- Browsing impacts on each tree species (High, Medium, Low, Absent) (Table 1).

The field survey took place over 20 days between the 2<sup>nd</sup> and 24<sup>th</sup> of May 2021, this allows comparison with the 2018 survey which took place between the 15<sup>th</sup> and 31<sup>st</sup> of May 2018. To ensure consistency of the collection of data across the survey, all plots were visited by the same surveyor, Steven Heaton MSc MCIEEM.

The definition of seedlings and saplings was taken as any tree species  $< 5\text{ m}$  tall and with a DBH (Diameter at breast height 1.3m) of  $< 7\text{cm}$ .

**Table 1.** Current herbivore browsing impact definitions

<b>Current Browsing</b>	<b>Very High</b>	<b>High</b>	<b>Medium</b>	<b>Low</b>	<b>Absent</b>
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<b>Current Browsing</b>	<b>Very High</b>	<b>High</b>	<b>Medium</b>	<b>Low</b>	<b>Absent</b>
<b>Seedlings and saplings</b>	Palatable species, if present, will be >90% browsed with many woody side shoots browsed back or snapped. Leading shoots will be unbrowsed only if they cannot be reached by herbivores. Unpalatable, class 4 or 5: 75-90% or >90% browsed. Unpalatable, class 6: 25-75% browsed.	Palatable species, if present, will be 75-90% browsed. If the survey is taking place during the growing season, seedlings in their first year, if present, may be unbrowsed. Unpalatable, class 4 or 5: 25-75% browsed. Unpalatable, class 6: <25% browsed.	Palatable species generally 25-75% browsed; a few may be 75-90% browsed. Unpalatable, class 4 or 5: <25% browsed: Unpalatable class 6: unbrowsed	Palatable species generally <25% browsed; a few maybe 25-75% browsed. Unpalatable: all species unbrowsed.	No browsing.

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<b>Preferentially browsed species</b>	Restricted to inaccessible locations.	Heavily browsed (>75% shoots browsed).	Moderately browsed (25-75% shoots browsed).	Lightly browsed (<25% shoots browsed).	Vegetation may be thickets of palatable species e.g. bramble, woodrush.
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Preferentially browsed species recorded in the previous 2018 survey comprised blueberry, bramble, dog rose, greater woodrush, ivy, honeysuckle, bog myrtle and ferns (other than bracken).

Tables 2 and 3a and b, taken from Armstrong *et al.* (2014), are tables of relative palatability of non-tree and tree species respectively.

**Table 2.** Table of relative palatability of non-tree species (**Bold = cattle only**, *Italic = deer only*)

Season	Very palatable	Moderately palatable	Unpalatable
All year	Bramble, Honeysuckle, Ivy, Blaeberry, <b>Greater woodrush</b> , Common Bent, Red Fescue, Yorkshire fog	<i>Hard fern</i> , Bog myrtle, Heather (Ling), Bell heather, Sheep's fescue	Hard fern, Greater woodrush, Purple moor-grass, Mat grass, Tufted hair-grass, Soft and Sharp-flowered rush, Cross-leaved heath
Spring - Summer	As above. In addition: Valerian, Meadowsweet, Angelica, Dog's mercury, Raspberry, <i>Buckler ferns</i>	Devil's-bit scabious, <b>Purple moor-grass</b> , <b>Soft and Sharp-flowered rush</b> , <i>Lemon-scented fern</i> , <i>Lady fern</i>	Buckler ferns, Lemon-scented fern, Lady fern, Primrose

**Table 3a.** Table of relative palatability tree species

Palatability class (Innate attraction of shoots to browsing animals)	-	Species
Palatable	1-Most palatable	Aspen, Ash, Elder, Willow
Palatable	2	Elm, Hazel, Holly, Oak, Rowan
Palatable	3	Blackthorn, Douglas Fir, Gean, Hawthorn, Larches, Sycamore, Yew
Unpalatable	4	Birch, Beech, Lodgepole Pine, Scots Pine
Unpalatable	5	Bird cherry, Juniper, Norway Spruce, Western Hemlock
Unpalatable	6-Least palatable	Alder, Rhododendron, Sitka Spruce

**Table 3b.** Table of relative palatability and resilience of tree species

<b>Resilience (Ability of seedlings /saplings to survive being browsed and to continue to grow)</b>	<b>Species</b>
1-Most Resilient	Alder, Birch, Bird cherry, Eared Willow, Hawthorn
2	Blackthorn, Holly, Juniper,
3	Ash, Elm, Hazel, Oak, Rowan, Sycamore
4-Least Resilient	Scots pine and non-native conifers

## Results

Within the survey area, 122 sample plots were assessed for herbivore impacts. Numbers of sample plots, including numbers of plots within each of the different management units, and the number of plots within exclosures, are summarised in Table 4 below.

**Table 4.** Number of sample plots

<b>Property</b>	<b>Unenclosed plots</b>	<b>Enclosed plots</b>	<b>Total number of plots</b>
North Assynt Estate	5	16	21
Ardvar Estate	65	14	79
Quinag Estate (JMT)	13	0	13
Kylesku*	1	0	1
Reintraid	8	0	8
<b>Total</b>	<b>92</b>	<b>30</b>	<b>122</b>

\*the single plot on Kylesku is not within the SSSI and has been included within Quinag for all calculations

## Current herbivore impacts on Seedlings and Saplings and Preferentially Browsed Herbs

The herbivore impact levels were recorded as either VH = Very High, H = High, M = Medium, L = Low or N = Absent. Where an indicator was not present, this was recorded as NA. In total, seedlings and saplings were found in a total of 113 plots, and preferentially browsed herbs in 116. Plots for which an indicator was absent were not included in calculating impacts for that indicator.

Table 5a and b shows the overall percentage of plots recorded in each impact class for the two indicators that were assessed during the survey (Seedlings and Saplings, and Preferentially Browsed Herbs), in each estate.

Table 6a and b, and table 7a and b show the overall percentages of plots recorded in each impact class both inside and outside exclosures, for Seedlings and Saplings and Preferentially Browsed species respectively, in each estate. The results show that for plots within deer fenced exclosures the herbivore impacts are, as would be expected, lower than those plots outside of exclosures. However, 36% of the plots outside exclosures were recorded as having High or Very High herbivore impacts on seedlings and saplings.

**Table 5a.** Herbivore impacts on seedlings and saplings (excludes plots where indicators were absent)

Estate	VH%	H%	M%	L%	N%
Overall	0.89	26.55	46.02	9.73	16.81
North Assynt	0	0	26.31	31.58	42.11
Ardvar	0	26.39	52.78	5.55	15.28
Quinag	0	50	50	0	0
Reintraid	12.5	50	25	12.5	0

**Table 5b.** Herbivore impacts on preferentially browsed herbs (excludes plots where indicators were absent)

<b>Estate</b>	<b>VH%</b>	<b>H%</b>	<b>M%</b>	<b>L%</b>	<b>N%</b>
Overall	0.86	15.52	47.41	23.28	12.93
North Assynt	0	0	15	70	15
Ardvar	0	11.84	55.26	17.11	15.79
Quinag	0	38.46	61.54	0	0
Reintraid	14.29	57.14	28.57	0	0

**Table 6a.** Herbivore impacts on seedlings and saplings inside exclosures (excludes plots where indicators were absent)

<b>Estate</b>	<b>VH%</b>	<b>H%</b>	<b>M%</b>	<b>L%</b>	<b>N%</b>
Overall	0	0	0	29.63	70.37
North Assynt	0	0	0	42.86	57.14
Ardvar	0	0	0	15.38	84.62
Quinag	NA	NA	NA	NA	NA
Reintraid	NA	NA	NA	NA	NA

**Table 6b.** Herbivore impacts on seedlings and saplings outside exclosures (excludes plots where indicators were absent)

<b>Estate</b>	<b>VH%</b>	<b>H%</b>	<b>M%</b>	<b>L%</b>	<b>N%</b>
Overall	1.16	34.88	60.47	3.49	0
North Assynt	0	0	100	0	0

<b>Estate</b>	<b>VH%</b>	<b>H%</b>	<b>M%</b>	<b>L%</b>	<b>N%</b>
Ardvar	0	32.2	64.41	3.39	0
Quinag	0	50	50	0	0
Reintraid	12.5	50	25	12.5	0

**Table 7a.** Herbivore Impacts on preferential browsed herbs inside exclosures. (Excludes plots where indicators were absent)

<b>Estate</b>	<b>VH%</b>	<b>H%</b>	<b>M%</b>	<b>L%</b>	<b>N%</b>
Overall	0	0	0	48.28	51.72
North Assynt	0	0	0	80	20
Ardvar	0	0	0	14.29	85.71
Quinag	NA	NA	NA	NA	NA
Reintraid	NA	NA	NA	NA	NA

**Table 7b.** Herbivore Impacts on preferential browsed herbs outside exclosures. (Excludes plots where indicators were absent)

<b>Estate</b>	<b>VH%</b>	<b>H%</b>	<b>M%</b>	<b>L%</b>	<b>N%</b>
Overall	1.15	20.69	63.22	14.94	0
North Assynt	0	0	60	40	0
Ardvar	0	14.52	67.74	17.74	0
Quinag	0	38.46	61.54	0	0

Estate	VH%	H%	M%	L%	N%
Reintraid	14.29	57.14	28.57	0	0

## Overall current browsing impacts

The overall browsing impact level for each plot was worked out by using the highest of the two impact scores for the two categories recorded at each survey plot. This data was then collated to make Figure 1.

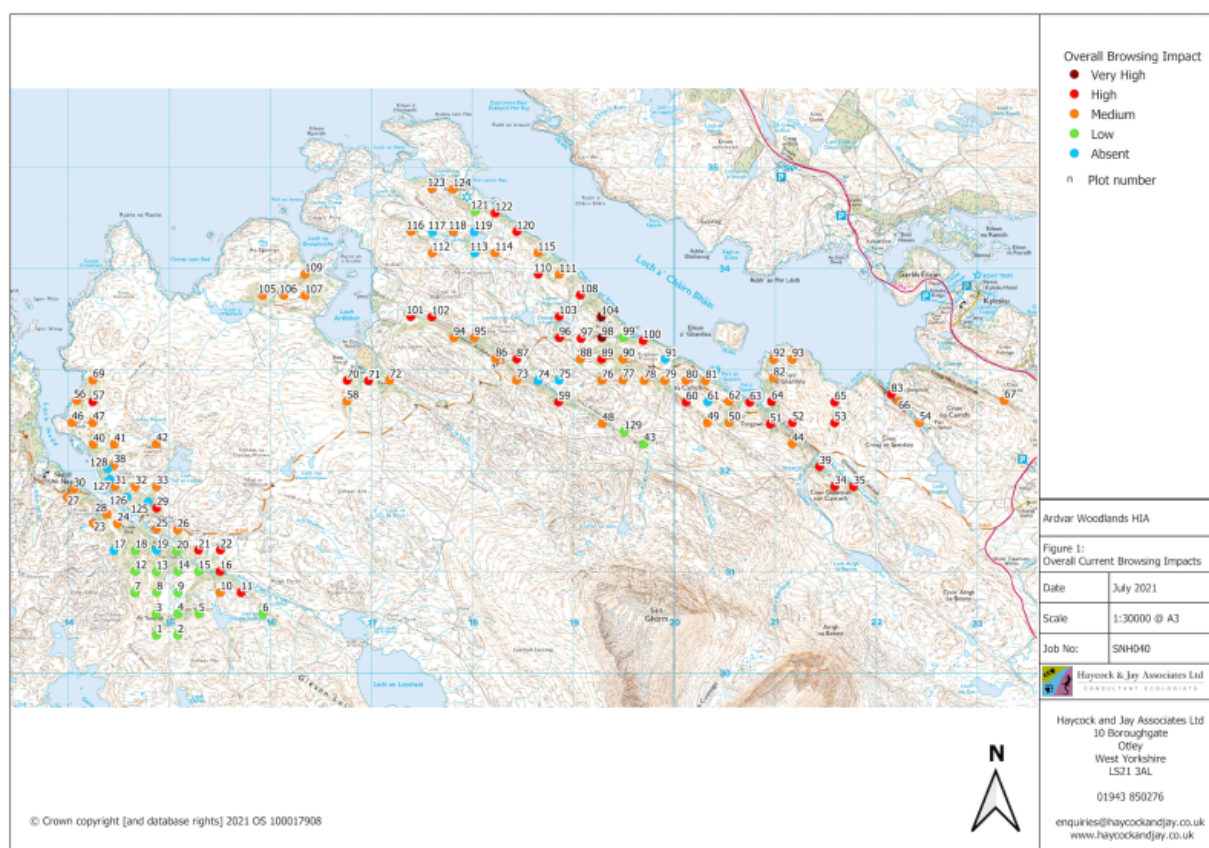


Figure 1. Map of overall current browsing impacts across Ardvar Woodlands

Table 8 shows the percentages of plots with each overall browsing impact level across the whole of the woodland. 46% of plots have medium overall browsing impacts, however a quarter (26%) of the plots had high overall browsing impacts. Except for two plots (Plots 121 & 99) all the plots that recorded No Impact or Low impact were located within enclosures. Both of these plots are near to buildings, Kerrachar (121) and Reintraid (99).

**Table 8.** Percentage overall current browsing impacts across the whole woodland

-                      **No Impact    Low       Medium    High       Very High**

-	No Impact	Low	Medium	High	Very High
Percentage (%)	10.66	15.57	45.90	26.23	1.64

### Current browsing impacts for each property

Table 9 shows the current overall browsing impacts broken down for each property, this is recorded as the percentage of plots for each in each impact category. It is notable that Quinag (14 plots) and Reintraid (8 plots) have a higher percentage of plots assessed as having a High herbivore impact level than Ardvar (79 plots). North Assynt currently has no high impacts, however most of the plots are located within enclosure A (16 out of 21 plots).

Tables 10 and 11 show the current browsing impacts for Ardvar and North Assynt inside and outside exclosures. Even when taking into account enclosed areas, both Quinag and Reintraid have a higher percentage of plots recorded as High or Very High. However, comparisons of impact levels between estates should not be made because of the very different number of plots surveyed at each estate. It was notable that during this survey sheep were being grazed on parts of the Quinag and Unapool land; this had previously not been the case in 2018.

**Table 9.** Current browsing impacts for each property by % of plots

-	No Impact	Low	Medium	High	Very High
North Assynt (21 plots)	9.52	66.67	23.81	0	0
Ardvar (79 plots)	13.92	5.06	55.70	25.32	0
Quinag (14 plots)	0	0	42.86	57.14	0
Reintraid (8 plots)	0	12.5	12.5	50	25

**Table 10.** Current browsing impacts for Ardvar Estate inside and outside exclosures % of plots

-	No Impact	Low	Medium	High	Very High
Plots In Exclosures	78.57	21.43	0	0	0

-	No Impact	Low	Medium	High	Very High
Plots Outside Enclosures	0	1.54	67.69	30.77	0

**Table 11.** Current browsing impacts for North Assynt Estate inside and outside enclosures % of plots

-	No Impact	Low	Medium	High	Very High
Plots In Enclosures	12.5	87.5	0	0	0
Plots Outside Enclosures	0	0	100	0	0

### Field layer vegetation height for each property

Table 12 shows the average height of the field layer vegetation recorded in the plots for each estate, with enclosure areas shown separately. For the average height of field layers within individual plots please refer to the raw data, supplied separately to this document.

On the whole the average field layer vegetation height across the different estates appears to be remarkably consistent. However, it is noticeable that the plots at Reintraid have a lower-than-average field layer vegetation height. This could be explained by the fact that 75% of the plots on the estate have high or very high impact levels.

On the Ardvar Estate, where the enclosures have been established for a longer period of time than on the other estates, the field vegetation height within the enclosures is on average over 10cm higher than outside the enclosures. In open areas within some of these enclosures the field layer is now presenting a considerable barrier in woodland expansion and regeneration (pers. obs.).

**Table 12.** Average field layer vegetation height recorded in the plots in each estate. Vegetation height (Metres)

-	North Assynt	Ardvar	Reintraid	Quinag	Whole Woodland
Whole property	0.242	0.243	0.175	0.243	0.238
Plots in enclosures	0.246	0.336	NA	NA	-

-	North Assynt	Ardvar	Reintraid	Quinag	Whole Woodland
<b>Plots not in exclosures</b>	0.23	0.222	0.175	0.243	-

### Average height of seedlings within survey plots

The actual heights of the ten nearest seedlings to the centre of the plot recorded for each individual plot are available in the raw data, supplied separately to this document. Table 13 groups the average height of seedlings into four height categories and displays the percentages of plots which fall within each.

The results show that in just under half of plots (47.8%), the average heights of the ten nearest seedlings to the centre of the plot were in the smallest height category of 10cm or less. In the vast majority of plots (93.8%) the average seedling height was less than 100cm. The table also shows the results for the 2018 survey.

**Table 13.** Average height of the ten nearest seedlings to the centre of the plot

Average seedling height category	0-10cm	11-50cm	51-100cm	>100cm
<b>Percentage of plots 2018</b>	56%	30%	10%	4%
<b>Percentage of plots 2021</b>	47.8%	38.9%	7.1%	6.2%

In total, 58% of all seedlings measured were 10cm or less, and 94% of seedlings were 1m or less.

### Stocking density

Table 14 shows the overall stocking density (stems per hectare) for seedling and saplings of tree species across the entire site. The table shows that, except for birch, very few of the species are establishing past the large seedling stage.

**Table 14.** Stocking Density Across the Site for seedlings and saplings (stems per hectare)

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
<b>Birch</b>	64.1	136.2	42.3	6.4	249

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
Rowan	355.4	191.1	2	0.3	548.8
Holly	1.1	6.1	0	0	7.2
Hazel	3.4	3.9	0.2	0	7.5
Willow	2.5	3.8	0.3	0	6.6
Aspen	0	0.8	0	0	0.8
<b>Total per life stage</b>	426.5	341.9	44.8	6.7	Total stocking density 819.9

Tables 15 to 17 show the stocking densities in the different estates. Ardvar Estate has the highest average total stocking density, however this is in part due to very high rowan seedling counts in some of the exclosures.

**Table 15.** North Assynt Stocking Density (stems per hectare)

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
Birch	19.04	194.3	53.3	5.7	272.32
Rowan	158	84.8	3.8	0	246.6
Holly	1.9	3.8	0	0	5.7
Hazel	1.9	1	0	0	2.9
Willow	1	13.3	1.9	0	16.2
Aspen	0	4.8	0	0	4.8

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
<b>Total per life stage</b>	181.84	302	59	5.7	Total stocking density 548.54

**Table 16.** Quinag Stocking Density (stems per hectare)

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
<b>Birch</b>	45.5	167.3	132.7	47.3	392.8
<b>Rowan</b>	83.6	50.9	5.5	1.8	141.8
<b>Holly</b>	0	0	0	0	0
<b>Hazel</b>	0	1.8	1.8	0	3.6
<b>Willow</b>	0	1.8	0	0	1.8
<b>Aspen</b>	0	0	0	0	0
<b>Total per life stage</b>	130.9	221.8	138.2	49.1	Total stocking density 540

**Table 17.** Ardvar and Reintraid Estates Stocking Density (stems per hectare)

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
<b>Birch</b>	77.8	117.5	29	1.6	225.9
<b>Rowan</b>	439.6	234.6	1.1	0.2	675.5
<b>Holly</b>	1.1	7.4	0	0	8.5

Species	Small Seedling	Large Seedling	Small Sapling	Large Sapling	Total stocking density
Hazel	4.3	4.9	0	0	9.2
Willow	3.1	1.8	0	0	4.9
Aspen	0	0	0	0	0
<b>Total per life stage</b>	525.9	366.2	30.1	1.8	Total stocking density 924

### Other factors that may affect the performance of tree regeneration

Only 22 plots or 18% of plots have no other factors listed that might be limiting regeneration. However, even if some inhibitory factors are present, these don't necessarily mean that the entire plot is unsuitable. This is illustrated by the fact that only nine of the plots contained no seedlings, compared to 102 plots (84%) where it was possible to record at least 10 seedlings.

### Comparison of 2021 stocking density and the previous 2016 survey

There is a major constraint in drawing comparisons between the stocking density survey of this survey (May 2021) and the one from 2016.

The previous 2016 survey was carried out during September and October through necessity which meant the seedlings and saplings had an entire growing season to germinate and grow. The fieldwork for this assessment took place in May (during a cool late spring), straight after the critical winter browsing period, which has a particularly big impact on tree regeneration. The 2021 stocking density is lower than that of 2016 but due to the variation in seasons when the data was gathered it is difficult to draw any conclusions from this and so currently no comparisons have been made.

### Comparison of Current overall browsing impacts outside of exclosures with the Previous 2018 Survey

Using the overall browsing impacts for all plots that are not in exclosures, a comparison can be made with the 2018 survey for the percentage of plots in each impact category. These are presented in Table 18 below. Whilst the percentage of plots with a medium impact has stayed the same the percentage of plots recorded as high or very high has increased in the 2021 survey.

**Table 18.** Comparison of overall browsing impacts 2018 and 2021 outside of exclosures

Year of survey	No Impact%	Low %	Medium%	High%	Very High%
2021	0	2	60	36	2
2018	0	8	60	32	0

Since the overall impact level is worked out by using the highest of the two impact scores for the two categories (seedlings and saplings, and preferentially browsed herbs) recorded at each survey plot tables 19 and 20, presented below, compare the impact levels on each of these categories with the 2018 data.

For impact levels on preferentially browsed species the percentage of plots with low or high impact levels have decreased since 2018, and the number of plots with medium impacts have increased by close to 9%. For impact levels on seedling and saplings the percentage of plots with a low or medium impacts have decreased since 2018, and the number of plots with a high impact has increased by close to 10%. Therefore, it is the increase in browsing impact levels on seedlings and saplings that has resulted in an increase in percentage of plots with a high overall browsing impact when compared to the 2018 data.

**Table 19.** Comparison of preferentially browsed herb browsing impacts 2018 and 2021 outside of exclosures

Year of survey	No Impact%	Low %	Medium%	High%	Very High%
2021	0	14.94	63.22	20.69	1.15
2018	0	18.45	54.37	25.24	0

**Table 20.** Comparison of seedling and sapling browsing impacts 2018 and 2021 outside of exclosures

Year of survey	No Impact%	Low %	Medium%	High%	Very High%
2021	0	3.44	60.47	34.88	1.16
2018	0	13.86	71.29	14.85	0

## Discussion

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### Seedling and sapling height

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This survey is the first repeat of the baseline assessment undertaken in 2018, and as such it may still be too early to conclude anything from comparing the data. It is notable, however, that the percentage of plots with an average seedling height under 10cm has gone down whilst the percentage of plots with an average seedling height between 11-50cm has gone up in this repeat survey (see Table 13). This may indicate that there has been some progression in seedling development and woodland structure, however this survey will need repeating several times every two years to draw any conclusions. It was observed during survey that no tree species, other than birch in open areas, currently appear to be getting to sapling stages in any significant proportion, if at all.

### Preferentially browsed species

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When compared to 2018 the percentage of plots with low and high impact levels of browsing on preferentially browsed herbs have both decreased, but the percentage of plots with medium impacts has increased, making it difficult to assess whether the browsing impacts on preferentially browsed herbs have significantly changed.

It is notable that there appears to be fewer seedlings of some preferentially browsed tree species such as rowan than in 2018, this could be caused by the sustained levels of browsing. It could also be due to 2021 having a long cool spring which meant that small seedlings were less apparent or seeds were slower to germinate when compared to the heat wave of 2018. However, it should be noted that seedlings of preferentially browsed tree species such as rowan, oak and aspen will struggle to establish and reach sapling stage even with medium browsing impact levels.

### Success of exclosures

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Since the 2018 survey a large proportion of the woodland on the North Assynt Estate has been fenced within an exclosure. Table 11 shows that the herbivore impact levels in this area now appear lower than the 2018 survey results, as would be expected. However, the area had been fenced too recently to see any progression in seedling and sapling development within this exclosure. This should become more apparent in subsequent surveys.

Small exclosures in the woodland around Nedd Bay on the Ardvar Estate (exclosures N1, N2, N3 and N4), that were erected just before the previous survey in 2018, now have lots of seedling regeneration within them with particularly high counts for rowan seedlings. Hazel and holly seedlings were also recorded within these exclosures. Over time these exclosures should provide a valuable seed source for the surrounding woodland. Further small exclosures in other areas across the woodland may prove useful in helping the woodland structure develop and improve its heterogeneity. Such exclosures could also be used to help the regeneration of species such as oak and aspen. It was also noticeable in

the Nedd Bay area on the Ardvar Estate that a few large hazel seedlings outside of the exclosures and survey plots, whilst being browsed, were starting to reach sapling stage, and grow above the browse line. This was the only area of the entire woodland where this was observed other than on inaccessible cliffs and ledges.

For other larger exclosures within the Ardvar Estate it is more difficult to judge any success and more time is needed to make an assessment of whether the structure of the woodlands within them is improving.

It was very noticeable in open areas within some of these larger exclosures that the vegetation was getting quite tall, dense and dominated by rank vegetation, presenting a significant barrier to woodland expansion and seedling establishment (pers. obs.). In dry hot weather these areas may also present a significant fire risk due to the build-up of plant material. This could be an opportunity to discuss management within the exclosures.

## **Overall Herbivore Impacts**

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Assessing the browsing impacts on seedling and saplings and preferentially browsed herbs within woodland is essential in understanding the browsing levels within woodland. It is particularly important in understanding whether the woodland is recovering or not. Interpretation of the overall herbivore impacts present in this assessment needs some care.

Since the 2018 survey a large area of Ardvar woodlands on the North Assynt Estate has been fenced creating an exclosure which now contains 16 of the survey plots. In 2018 this area had some of the highest recorded impact levels with nine of the survey plots having high herbivore impact levels. It would be useful for the DMG to reflect on whether deer displaced from this area may be responsible for any increased herbivore pressure elsewhere within the woodlands. Additionally, 2021 had a much cooler spring than 2018, which may have resulted in red deer overwintering in the lower coastal areas, such as Ardvar, for longer.

Areas of the Quinag and Kylesku Estates north of the B869 are now being grazed by sheep and this appears to be increasing the herbivore impact levels in some of the plots in this area. However, areas of the Quinag woodland south of the B869 have seen an increase in herbivore impact levels and this appears to be entirely due to deer browsing.

Areas of the Reintraid Estate have high impacts with two plots recording Very High overall impact levels, it was notable that red deer were observed around plot 104 during both the 2018 and 2021 surveys and appear to be in this area much of the time.

## **Prognosis for woodland structure and expansion**

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The previous surveys in both 2016 and 2018 concluded that the woodland was at a 'tipping point' with the potential for a significant pulse of tree regeneration and expansion, as well as development of woodland structure, which could be achieved through a

sustained reduction in browsing pressure. The results of this HIA show that the current level of herbivore impact is still too great to allow tree regeneration (particularly of more palatable species) and structural development to progress. It remains the case that a sustained reduction in browsing is required.

Currently, 38% of the plots outside of enclosures have High or Very High impact categories (Table 18). In the future even if the herbivore impact target was to be set at medium, this target may not be sufficient for palatable tree species, such as rowan, hazel, oak, and holly etc. This is because even with medium impacts up to 75% of the annual growth of palatable seedling and sapling species could be being removed each year, and over time some of those species may not have the resilience to survive.

In order to achieve a greater diversity of tree species and woodland structure across Ardvar woodlands, it is suggested that consideration is given to setting a target for a significant percentage of plots outside of enclosures to have low impacts, and for the overall impact level to be no more than medium.

## Conclusions

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- Over the whole of Ardvar woodland the most frequent current herbivore impact level is Medium 46%, however, high impact levels are recorded in 26% of plots.
- For 48% of plots the mean height of the ten nearest seedlings and saplings to the centre of each survey plot is 10cm or less. For 39% of plots the mean height of the ten nearest seedlings and saplings is between 11-50cm.
- The herbivore impacts may have increased on the Quinag; much of this appears to be due to red deer, but sheep are also having an impact.
- Sheep are now grazing on the Quinag and Kylesku Estates north of the B869 and are adding to the browsing level in this area. In the rest of the woodland areas all other recorded signs of herbivore activity indicate that red deer are the main herbivore within Ardvar woodland.
- Deer fenced exclosures recorded low to no herbivore impacts.
- The creation of the large exclosure on the North Assynt Estate may have pushed deer that were using this area into other woodland areas.
- To aid seedling and sapling establishment, particularly for preferentially browsed tree species, such as rowan, hazel, and holly, the browsing impact levels need to be reduced across the whole of the woodland. A target for a significant percentage of plots outside of enclosures to have low impacts, and for the overall impact level to be no more than medium is suggested.
- Seedling and sapling stocking density was calculated, however, no comparison is made with the survey of 2016 due to the differences in the time of year that the surveys took place. The 2021 survey for stocking density should be considered a baseline to compare against future surveys, as the survey was not part of the 2018 HIA.

## References

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