

Crosby Ravensworth Fell

1. Overview of the site

1.1 Introduction

Natural England (NE) and its predecessors has carried out a series of monitoring programmes on many upland sites in England that contain Priority Habitats, including dry and wet heath, blanket bog and calcareous grassland. These sites have been managed under agri-environment schemes for up to two decades or more, and some were formerly also subject to grazing restrictions under Environmental Cross Compliance (ECC) regulations. Monitoring focussed initially on the condition of heather (*Calluna vulgaris*) in relation to grazing pressure, and latterly also on the overall condition of the vegetation across the range of habitats present on a site.

The aim of this project was to re-survey a selection of these sites using standardised methods, and to provide a series of individual site reports describing their current and changing habitat condition, along with a separate overview of the findings from the complete set of sites. Data from the surveys have also been provided to NE to allow more detailed examination of individual sites to help guide local management inputs.

Each site comprised a whole moorland grazing unit and encompassed a range of vegetation types. A range of variables was recorded at 100 randomly located sample points in each site. Variables to be recorded were agreed with NE prior to the survey, to assess heather grazing and the condition of key habitats. The methodology was based on a modified version of the NE overgrazing surveillance methodology (including laboratory assessment of a heather Grazing Index) and the Common Standards Monitoring (CSM) Guidance for Upland Habitats. Full details of the project objectives and methodology are given in the main overview report. [Defra, UK - Science Search](#)

Crosby Ravensworth Fell is located in Cumbria and is 2003 ha in area. It encompasses Crosby Ravensworth Fell SSSI and is part of the Asby Complex SAC. Crosby Ravensworth Fell was treated as two separate sites because of the contrasting characteristics of the western and eastern sections. The full survey methodology was applied to each site. The western section was re-surveyed during 12 – 13 February and the eastern during 16 – 17 February 2015. Management information (particularly grazing) is summarised below from reports provided by NE and results of the surveys of the western and eastern sections are then presented in a standard format in the following sections. An assessment is then made of change in vegetation since the previous surveys and this is considered in the context of current and past management practices.

1.2 Site management

Concerns about heavy grazing pressure on the common were first raised in 1993. At that time, average stocking rates in the western section were up to 3.1 ewes ha⁻¹, with annual average 1.6 ewes ha⁻¹, and in the eastern section were up to 2.7 ewes ha⁻¹, with annual average 2.4 ewes ha⁻¹. Stock numbers were reduced voluntarily in 1995 to an average of 1.3 ewes ha⁻¹ (maximum 3.0 ewes ha⁻¹). In 1996, Environmental Cross Compliance (ECC) regulations were imposed, which reduced overall maximum numbers from 6700 to 5879 ewes. In the western section, the average remained at 1.3 ewes ha⁻¹ but the maximum reduced to 2.1 ewes ha⁻¹. The site entered a Countryside Stewardship Scheme (CSS) agreement in 1999, which required maximum summer stocking rate between lambing and tugging of 0.15 LU ha⁻¹ (1.5 ewes ha⁻¹ plus followers) and 0.075 LU ha⁻¹ (0.75 ewes ha⁻¹ plus followers) in winter, resulting in a reduction in average ewe numbers to 1.2 per ha and maximum 1.5 per ha. Not all graziers signed up to the CSS agreement, those remaining still being subject to the previous overgrazing prescriptions. In 2001, livestock numbers were

substantially reduced due to the Foot and Mouth disease outbreak. The site entered a Higher Level Scheme (HLS) agreement in 2009, which specified a maximum overall grazing rate of 1.5 sheep ha⁻¹ and a minimum rate of 0.5 sheep ha⁻¹ or cattle equivalents¹. There was also a requirement to graze with cattle in summer, with minimum numbers specified for individual graziers. Burning of dry and wet heath was also required under the HLS agreement, respectively on 10 – 15 and 15 – 20 year rotations. Burning is also limited to areas of tall heather with high cover.

A number of surveys have taken place over the last 20 or so years, and are summarised in Table 1. Early surveys up to 2001 focussed on grazing pressure on dwarf shrub, deriving a heather grazing index (GI) from shoots collected in the field. This was converted to a measure of Biomass Utilisation (BU) using a mathematical function, latterly reverting to the more objective GI measure only. Following entry of the majority of graziers into CSS in 1999, only the area grazed by non-agreement holders was surveyed in the following two years, to monitor compliance to the overgrazing prescriptions. The development of the Surveillance Survey following the Moorland Appraisal Pilot Project (MAPP) in 2002 saw a more holistic approach to the assessment of grazing pressure and added the measurement of sward heights, which could be compared to threshold heights for broad habitats, below which a sample area is deemed to be heavily grazed. Some sward height data had been collected in previous surveys, but not used in reporting. Other surveillance variables including dwarf shrub heights, the presence of suppressed heather growth features, bare ground, animal droppings etc are measured as part of these surveys. Surveillance surveys were often carried out on land where overgrazing measures had been implemented, but had subsequently entered an agri-environment agreement. Subsequent surveys covered only part of the common, the western section in 2003 and 2006, and eastern section in 2007, with this split maintained in the current (2015) survey to facilitate analysis. The various types of grazing assessment survey undertaken on Crosby Ravensworth Fell are set out in Table 1.

Table 1: Past surveys of grazing pressure and impacts on Crosby Ravensworth Fell, with the type of survey and sampling strategy followed.

Years	Area	Survey type	Main variables	Sampling Strategy	Sample numbers
1994, 1995, 1996, 1998, 1999	Whole Common	Overgrazing	HGI, BU	grid	c330
2000, 2001	Non-agreement area	Overgrazing	HGI	grid	164
2002	East	MAPP	HGI, sward heights	grid (offset)	103
2003	West	Surveillance	HGI, sward heights	grid	120
2006	West	Surveillance	HGI, sward heights	random	280
2007	East	Surveillance	HGI, sward heights	random	120

¹ Note that LU equivalents have varied among different schemes

3. Crosby Ravensworth Fell (West)

3.1 General description

The western section comprises 1532 ha. Much of the site is heather heath (27% of sample points in 2014; Figure 1), rough acid grassland (23%) and bent-fescue grassland (11%). Overall diversity is relatively low, although there are also areas of good quality wet heath (10%) at Hardendale Fell and north of Hause Farm. Fragmented heath (8%) and bracken (8%) are the other main vegetation types, the latter dominant at the edge of the moor, especially along the eastern side of the motorway. There is a small amount of calcareous grassland (CG9b *Sesleria albicans* [*caerulea*] – *Galium sternerii* grassland, typical sub-community) towards the eastern end of this section, which is relatively impoverished and tightly grazed by sheep and rabbits. There are also localised areas of heather that have been grazed heavily by rabbits.

Heather is present over much of the central part of the site (44% of sample points), with mean overall cover of 23% (Figure 3a). The majority of heather was in the building (50%) and mature (43%) growth stages, but with small amounts of pioneer and degenerate also present (Figure 3c). No recent burning was recorded at sample points, although numerous older small burns for grouse were observed during the field survey, some of which were dominated by pleurocarpous moss. *Nardus stricta* was the most commonly dominant graminoid (36% of sample points), with *Festuca ovina* dominant at 19% of points (Figure 3h).

3.2 Condition and grazing pressure in 2015

Current levels of grazing are moderately high in the heather heath, with mean GI at 40% (Table 2), and just over half of the samples failing to meet the CSM GI target of less than 33%, above which level grazing is likely to be damaging to. In wet heath, grazing levels are lower (mean GI 27%) and most samples met the target. Overall, 44% of samples with heather had a GI at or above 33% (Figure 2, Table 2 Map 1), distributed widely around the interface between heather and grassland, along the east-facing slopes around Coalpit Hill, and in the east of the site. Heavily grazed features were also present at 52% of sample points in heather heath where heather was present, but fewer (29%) in wet heath, and around 50% overall (Figure 3d, Map 2). This attribute tends to reflect longer-term heavy grazing and had a similar distribution to points with a high GI. In the other target habitats combined (blanket bog, flushes fens & swamps and fragmented heath), GI levels were comparable to those in heather heath. However, sheep droppings were recorded less frequently in heather heath (4%) than in wet heath (30%) and the other target habitats (39%). The mean sward height at 22% of sample points where graminoids could be measured, or 19% overall, indicated that heavy grazing was likely in these areas (Map 2). The distribution of these points was similar to heavily grazed dwarf shrub, with additional locations on grassland in the north and south of the site, including on land between the motorway lanes.

The dry heath habitat was below the condition assessment thresholds (targets to be passed at 90% of sample points) for number of indicator species and levels of browsing on dwarf shrubs. As well as the current levels of grazing, the shortage of indicator species is probably a legacy of heavy grazing in the past. If the measure of dwarf shrub cover is taken as indicator species cover, which for Crosby Ravensworth West is a reasonable assumption as *Racomitrium lanuginosum* was only recorded at 3% of dry heath sample points, this threshold is similarly not met, despite a mean dwarf shrub cover for dry heath of 63% overall, including fragmented heath samples, or 67% if fragmented heath samples are omitted. Condition assessment thresholds for dwarf shrub composition are however met. The wet heath habitat was above the threshold for browsing on dwarf shrubs and also for the presence of *Erica tetralix*. However, it was below the threshold for cover of indicators and relative covers of dwarf shrubs and graminoids, also suggesting past heavy grazing. Wet heath also failed on burning into the bryophyte layer (assessed at site level) as did the mires habitat.

3.3 Change since previous surveys

Surveys carried out during 1994 – 1999 concluded that the common was significantly overgrazed. For example, in 1996 the overall mean GI was 48%, and in 1999 in this, western section it was 54% with 60% of the area of heather being suppressed. In 2000 and 2001, surveys of areas not covered by the CSS agreement showed they were significantly overgrazed.

Further surveys of this, western section concluded there had been a decrease in grazing between 2000 and 2003, but in 2006 there had been little improvement in vegetation condition and the SSSI interest features were in unfavourable condition and probably not recovering.

The previous survey in 2006 used a similar sampling method to that in 2015. The heather grazing index was significantly higher in 2015 than 2006 ($F_{1,147} = 8.6$, $P < 0.01$; Table 2). The GI in 2015 might be an underestimate because the site has been summer grazed by cattle under HLS since 2009 (no cattle droppings were evident by the time of the survey in February). Taking covers, heights and detached stems collectively, there was no significant difference between 2006 and 2015, although mean dwarf shrub cover increased significantly from 22% to 27%, and mean graminoid height increased from 6.1 cm to 10.8 cm (Table 3). No significant changes were detected in the frequency of livestock droppings, heavily grazed features on heather or recent burning (Table 4). Overall, the evidence suggests that grazing levels have not reduced during the last nine years. However, the increases in graminoid height and dwarf shrub cover suggest some minor improvement, despite the fact that the GI was higher in 2015 than at the last survey in 2006.

Current grazing levels on the site still appear to be higher than optimum, although since the 1990s they have been substantially reduced under CSS and HLS. The more recent management under HLS appears to have coincided with a small improvement in the cover of heather, but species composition in the target habitats is still relatively impoverished and likely to take much longer to recover. Burning management has damaged the bryophyte layer in the wet heath and mires habitats. Although burning is permitted in wet heath on a long rotation under the HLS agreement, other restrictions might be necessary to avoid ‘hot’ burns on these habitats.

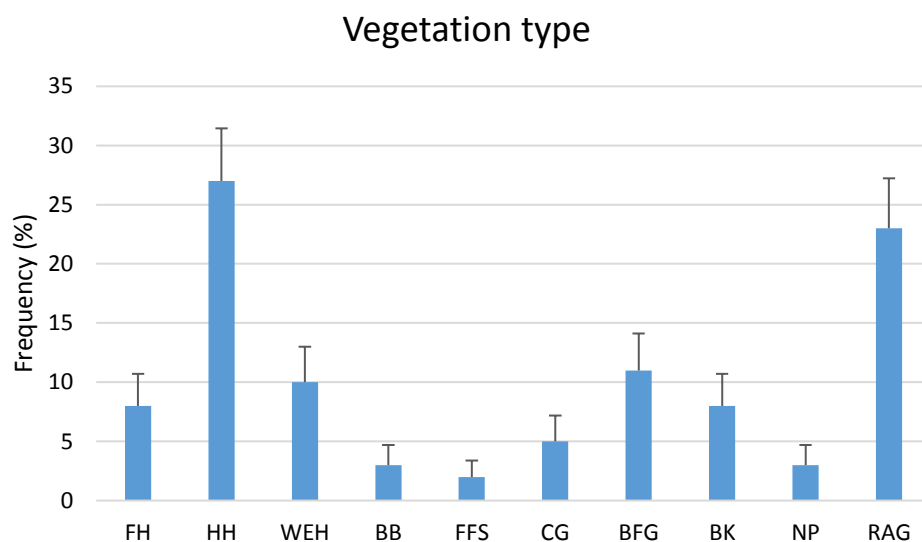


Figure 1. Frequency of vegetation types across the site in 2015. Bars are standard deviations. FH – fragmented heath; HH – heather heath; WEH – wet heath; BB – blanket bog; FFS – flushes, fens & swamps; CG – calcareous grassland; BFG – bent-fescue grassland; BK – bracken; NP – non-productive; RAG – rough acid grassland.

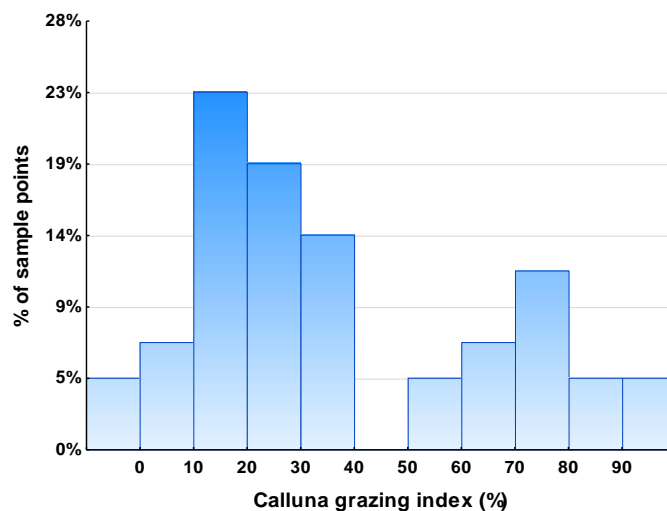


Figure 2. Frequency distribution of heather Grazing Index from sample points containing heather at whole site level in 2015.

Table 2. Heather Grazing Index in current (2015) and previous (2006) survey (mean \pm standard deviation; n is number of sample points with heather stems).

	2006		2015		
	Overall ($n = 106$)	Overall ¹ ($n = 43$)	Heather Heath ($n = 27$)	Wet Heath ($n = 7$)	Other ² ($n = 8$)
Grazing Index	22.5 \pm 30.61	38.3 \pm 28.74	40.1 \pm 26.78	26.5 \pm 26.67	39.1 \pm 37.63
Samples \geq 33.3%	14.2%	44.2%	51.9%	14.3%	37.5%
Samples \geq 66.6%	6.6%	27.9%	25.9%	14.3%	37.5%

¹ non-target habitats $n=1$

² blanket bog $n = 2$, flushes, fens & swamps $n = 1$, fragmented heath $n = 5$

Table 3. Cover, height and detached stems in current (2015) and previous (2006) survey (mean \pm standard deviation; n is total number of sample points (covers, detached heather), number of sample points containing bilberry, heather or graminoids (heights)). Detached vegetation was not recorded in 2006.

	2006			2015			$F_{1,9}$	P
	n	mean	st.dev.	n	mean	st.dev		
Dwarf shrub cover	276	22.2	± 35.16	97	27.3	± 34.66	6.6	<0.05
Bilberry cover	276	0.4	± 2.97	97	0.1	± 0.71	0.4	n.s.
Heather cover	276	20.5	± 35.59	97	23.4	± 32.43	5.1	n.s.
Bare ground	276	1.5	± 9.69	97	1.1	± 4.89	1.2	n.s.
Bilberry height	18	5.5	± 1.89	5	6.4	± 2.88	1.1	n.s.
Heather height	109	16.9	± 9.82	44	24.4	± 13.14	3.4	n.s.
Graminoid height	230	6.1	± 3.79	87	10.8	± 6.63	17.9	<0.01
Detached heather	276	0.4	± 1.19	97	0.3	± 1.04	0.1	n.s.
Overall							$F_{8,2}$	P
							0.9	n.s.

Table 4. Livestock droppings, burning and heavily grazed features in current (2015) and previous (2006) survey (presence, standard deviation and chi-square results; n is total number of sample points (droppings), number of sample points containing heather (heavily grazed features, burning)).

	2006			2015			$Chi\text{-square}$	P
	n	presence	st.dev.	n	presence	st.dev		
Livestock droppings	276	101	8.00	97	26	4.36	3.1	n.s.
Heavily grazed features	109	67	5.08	44	23	3.31	1.1	n.s.
Burning	113	9	2.88	44	0	0.00	2.4	n.s.

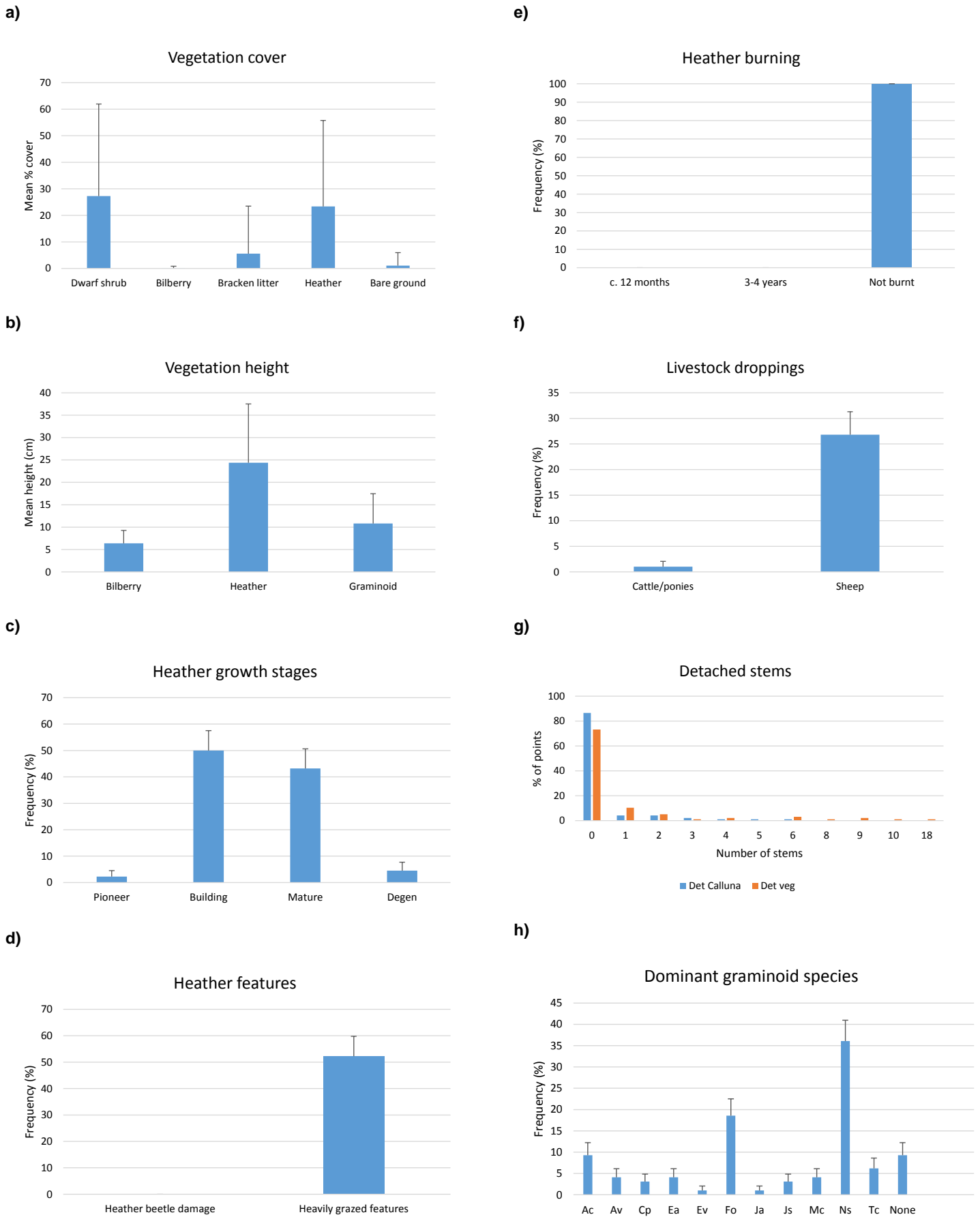


Figure 3. Surveillance variables at whole site level in 2015 (bars are standard deviations).

3.4 Overgrazing surveillance variables 2015

Category	Variable	Heather Heath (<i>n</i> = 27)			Wet Heath (<i>n</i> = 10)			Other Target Types* (<i>n</i> = 18)		
		Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>
Peat	Peat depth (cm)	15	5.4	24	34	7.2	10	33	20.7	13
Vegetation cover	Dwarf shrub cover (%)	67	23.3	27	52	28.2	10	17	27.0	18
	Bilberry cover (%)	0	1.0	27	0	0.0	10	0	1.2	18
	Bracken litter cover (%)	0	1.0	27	0	0.0	10	2	7.1	18
	Calluna cover (%)	61	23.8	27	33	38.2	10	16	24.5	18
	Bare ground (%)	2	7.7	27	0	0.3	10	1	2.4	18
Vegetation height	Bilberry height (cm)	6	2.6	3	-	-	0	7	4.2	2
	Calluna height (cm)	27	14.0	27	26	13.2	7	21	5.7	8
	Graminoid height (cm)	10	5.4	22	16	3.5	9	13	8.3	18
Heather growth stages	Pioneer (% of points)	4	3.6	27	0	0.0	7	0	0.0	8
	Building (% of points)	37	9.3	27	86	13.2	7	50	17.7	8
	Mature (% of points)	56	9.6	27	14	13.2	7	38	17.1	8
	Degenerate (% of points)	4	3.6	27	0	0.0	7	13	11.7	8
Heather features	Heather beetle damage (% of points)	0	0.0	27	0	0.0	7	0	0.0	8
	Heavily grazed features (% of points)	52	9.6	27	29	17.1	7	63	17.1	8
Heather burning	Burnt (c. 12 months) (% of points)	0	0.0	27	0	0.0	7	0	0.0	8
	Burnt (3-4 years) (% of points)	0	0.0	27	0	0.0	7	0	0.0	8
Droppings	Cattle / ponies (% of points)	0	0.0	27	0	0.0	10	0	0.0	18
	Sheep (% of points)	4	3.6	27	30	14.5	10	39	11.5	18
Detached stems	Detached Calluna (no.)	1	1.7	27	0	0.0	10	0.3	0.8	18
	Detached vegetation (no.)	0	0.5	27	0.1	0.3	10	2.4	4.8	18

* Other target types = Blanket Bog (*n*=3); Calcareous Grassland (*n*=5); Flushes, Fens & Swamps (*n*=2); Fragmented Heath (*n*=8)

3.5 Habitat condition assessment results 2015

3.5.1 Dry heath

Targets assessed at habitat level in 2 x 2 m quadrat:

Dry heath (n=27 heather heath + 5 fragmented heath)		
Target	% of points passed	Habitat pass or fail
Presence of moss, liverworts and non-crustose lichens ¹	100	Pass
At least 50% of vegetation cover made up of Table 1 indicator species ²	66	Fail
At least 25% of dwarf shrub cover should be made up of Group (i) indicator species	100	Pass
Less than 50% of dwarf shrub cover made up of Group (ii) indicator species	100	Pass
At least two indicator species from Group (i)	69	Fail
Cover of weeds < 1%	100	Pass
Cover of soft rush < 10%	100	Pass
Dwarf shrub browsing < 33%	50	Fail
Disturbed bare ground < 10%	100	Pass

¹ assessed in 1 x 1 m quadrat

² assessed as total dwarf shrub cover, excluding dead and pioneer heather and recent burns

Targets assessed at feature extent:

Target	Pass or fail
Cover of non-native species < 1%	Pass
Cover of bracken < 10%	Pass
Cover of native trees/ shrubs < 20%	Pass
Cover of weeds < 1%	Pass
Cover of soft rush < 10%	Pass
Burning of sensitive areas absent	Pass
Disturbed bare ground < 10%	Pass
Mature heather ≥10% & all growth phases present	Pass

Indicator species frequencies (n = 32):

Species	Frequency (%)	SD
<i>Calluna vulgaris</i>	100	0.0
<i>Erica tetralix</i>	47	8.8
<i>Erica cinerea</i>	31	8.2
<i>Vaccinium myrtillus</i>	9	5.2
<i>Vaccinium oxycoccus</i>	0	0.0
<i>Vaccinium vitis-idaea</i>	0	0.0
<i>Empetrum nigrum</i>	0	0.0
<i>Racomitrium lanuginosum</i>	3	3.1
<i>Ulex gallii</i>	0	0.0
<i>Myrica gale</i>	0	0.0

3.5.2 Wet heath

Targets assessed at habitat level in 2 x 2 m quadrat:

Wet heath (n=10 wet heath + 3 fragmented heath)		
Target	% of points passed	Habitat pass or fail
<i>Erica tetralix</i> present	100	Pass
At least 50% indicator species cover and 20% ericoid species	77	Fail
Cover of negative indicators < 1%	100	Pass
Cover of soft rush < 10%	92	Pass
Cover of dwarf shrubs ≤ 75% and graminoids ≤ 75%	77	Fail
Dwarf shrub browsing < 33%	92	Pass
Broken/ crushed <i>Sphagnum</i> < 10%	100	Pass
Disturbed bare ground/ drainage < 10%	100	Pass

Targets assessed at feature extent:

Target	Pass or fail
Cover of native trees/ shrubs < 20%	Pass
Cover of bracken < 10%	Pass
Cover of non-native species < 1%	Pass
Cover of negative indicators < 1%	Pass
Cover of soft rush < 10%	Pass
Burning of bryophyte layer absent	Fail
Burning of sensitive areas absent	Pass
Active drainage < 10%	Pass
Disturbed bare ground < 10%	Pass

Indicator species frequencies (n = 13):

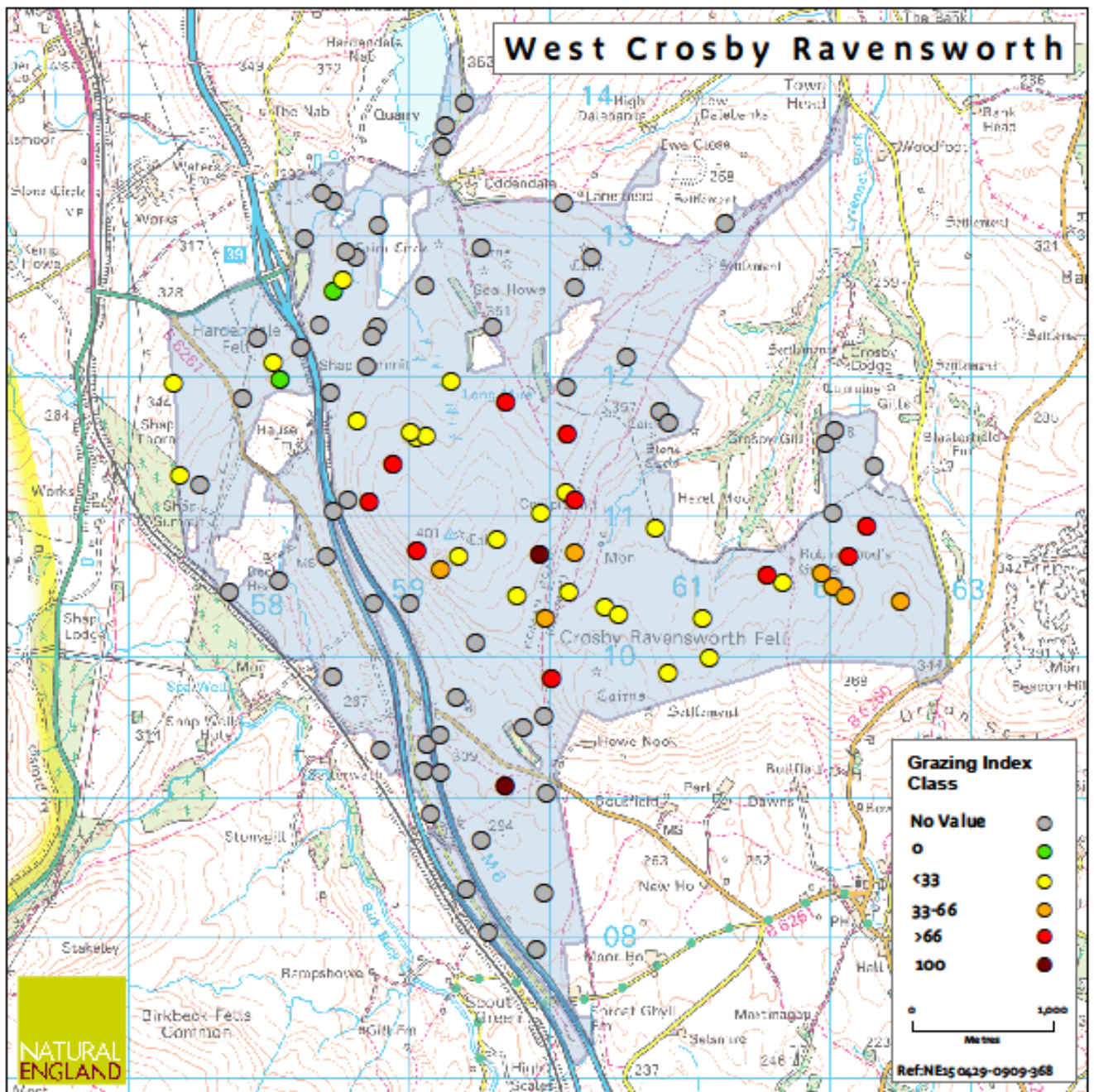
Species	Frequency (%)	SD	Species	Frequency (%)	SD
<i>Calluna vulgaris</i>	62	13.5	<i>Carex</i> spp.	62	13.5
<i>Erica tetralix</i>	100	0.0	<i>Rhynchospora alba</i>	0	0.0
<i>Erica cinerea</i>	8	7.4	<i>Narthecium ossifragum</i>	0	0.0
<i>Rubus chamaemorus</i>	0	0.0	<i>Drosera</i> spp.	0	0.0
<i>Empetrum nigrum</i>	0	0.0	<i>Sphagnum</i> spp.	54	13.8
<i>Myrica gale</i>	0	0.0	<i>Racomitrium lanuginosum</i>	8	7.4
<i>Andromeda polifolia</i>	0	0.0	Pleurocarpous mosses	92	7.4
<i>Eriophorum angustifolium</i>	15	10.0	Non-crustose lichens	31	12.8
<i>Trichophorum cespitosum</i>	31	12.8			

3.5.3 Mires

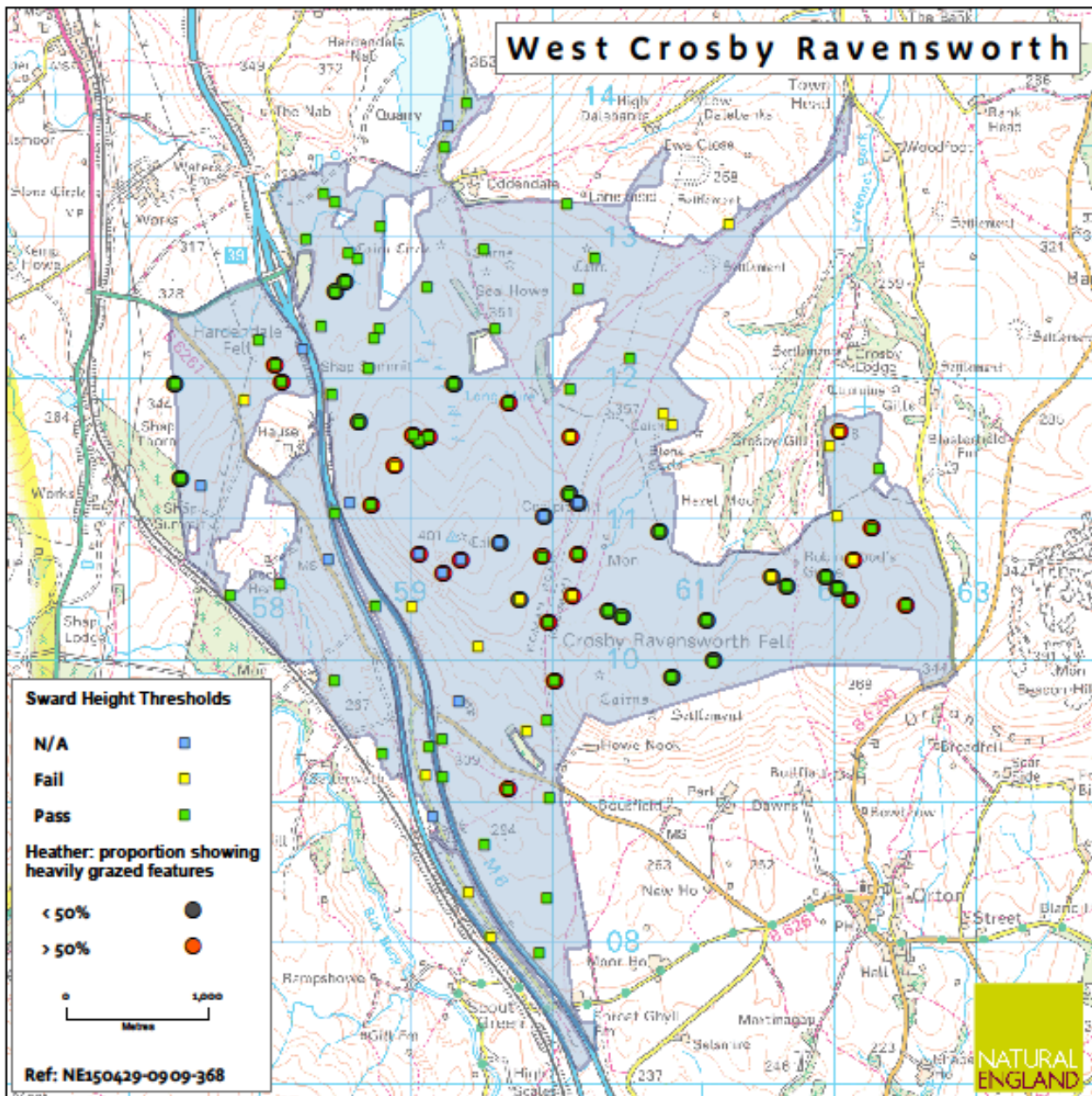
This habitat type was recorded at less than 10 sample points so condition cannot be accurately assessed at 2 x 2m quadrat level.

Targets assessed at feature extent:

Target	Pass or fail
Cover of non-native species < 1%	Pass
Cover of native trees/ shrubs < 10%	Pass
Cover of negative indicators < 1%	Pass
Burning of bryophyte layer absent	Fail
Burning of sensitive areas absent	Pass
Extent of eroding peat	Pass
Disturbed bare ground < 10%	Pass



Map 1: Distribution of random sampling points on Crosby Ravensworth Fell (west) in 2015, showing those where heather was present, along with heather grazing index (GI) class, derived from collected heather shoots.



Map 2: Distribution of sample points on Crosby Ravensworth Fell (west) in 2015, showing those which fall above (pass) or below (fail) habitat-related height thresholds indicative of heavy grazing, and with more or less than 50% of heather cover showing suppressed growth features.

4. Crosby Ravensworth Fell (East)

4.1 General description

The eastern section comprises 471 ha. Most of the site is either rough acid grassland (30% of sample points in 2015; Figure 4) or calcareous grassland (28%). The calcareous grassland (CG9b *Sesleria albicans* [caerulea] – *Galium sternerii* grassland, typical sub-community) appears to be relatively species-poor, dominated by *Sesleria caerulea* and was only lightly grazed, with rabbit droppings noted in some places. Exposed limestone is present over much of the southern part of the site, mainly comprising shattered limestone pavement, which has been quarried in the past. Heather heath (15%), fragmented heath (10%) and bent-fescue grassland (9%) are the other notable vegetation types on the site.

Heather is relatively infrequent on the site, occurring at only 22% of sample points and 9% cover overall in 2015 (Figure 6a). The majority of the heather was in the building growth stage (59% of sample points where it was recorded), but with pioneer and mature stages also prominent (Figure 6c). No recent burning was recorded. The most commonly dominant graminoids across the site were *Nardus stricta* (44% of sample points), *S. caerulea* (25%) and *Festuca ovina* (17%) (Figure 6h).

4.2 Condition and grazing pressure in 2015

Current levels of grazing are moderately high in the heather heath, with mean GI at 37%, and around 60% of the samples in heather heath failing to meet the CSM GI target of less than 33%, above which level grazing is likely to be damaging (Figure 5, Table 5, Map 3). These points are concentrated in the western central part of the site, and the northern arm. Heavily grazed features were also present at 27% of sample points containing heather (Figure 6d; Map 4). This attribute tends to reflect longer-term heavy grazing and had a similar distribution to points with a high GI. Detached vegetation was present at 23% of samples across the site, and detached heather at 5% (Figure 6g). However, sheep droppings were relatively infrequent (10%) and cattle droppings were only recorded once (Figure 6f). Only 3% of points had a mean graminoid sward height that suggested heavy grazing was likely in these areas (Map 4).

The calcareous grassland habitat did not meet the condition assessment target for forb cover at any of the sample points assessed. It was also below the condition assessment thresholds (targets to be passed at 90% of sample points) for variability in sward height and in having an excess of plant litter thatch. The lack of forbs might in part be a legacy of heavy grazing in the past, although the survey was carried out at sub-optimum time of year when forbs would have been less in evidence. The amount of plant litter might in fact indicate relatively low current grazing levels on this habitat, and would inhibit re-establishment of the typical range of plant species. The dry heath habitat only just failed to meet the thresholds for a number of condition assessment criteria. It was just below the thresholds for the number of indicator species and browsing on dwarf shrubs, and lacked heather in the degenerate growth stage. If the measure of dwarf shrub cover is taken as the indicator species cover attribute, which for Crosby Ravensworth east is a reasonable assumption as *Racomitrium lanuginosum* was not recorded at any sample points, this threshold is failed by a larger margin. The mean dwarf shrub cover for dry heath including fragmented heath samples is 43% overall, or 56% if fragmented heath samples are omitted. Condition assessment thresholds for dwarf shrub composition are however met.

4.3 Change since previous surveys

Surveys carried out during 1994 – 1999 concluded that the common was significantly overgrazed. For example, in 1996 the overall mean GI was 48%, and in 1999 in this, eastern section it was 70% with 88% of the area of heather being suppressed. In 2000 and 2001, surveys of areas not covered by the CSS agreement showed they were significantly overgrazed.

Further surveys in 2002 and 2007 in this, eastern section concluded that there had been some positive responses (such as an increase in dwarf shrub and heather frequencies) that might be attributed to the CSS grazing regime, and that some progress had been made in enhancing heather and other vegetation.

The previous survey in 2007 used a similar sampling method to that in 2015, although the grazing index was not assessed then. Taking covers, heights and detached stems collectively, there was a significant difference between the two surveys ($P < 0.05$; Table 6). During that period, mean cover of heather increased from 6% to 9% and mean graminoid height increased from 8 cm to 14 cm. No change was detected in frequencies of livestock droppings or heavily grazed features (Table 7).

Management of the site under HLS appears to have resulted in some continuing improvement in the heathland vegetation, which was first noted after entry into CSS agreement. This is despite the levels of grazing on heather that are currently higher than optimum. In contrast, there are some indications that grazing levels on calcareous grassland might be lower than optimum for this habitat, as indicated by the amount of dead litter and the increase in mean graminoid sward height across the site. *S. caerulea* is relatively unpalatable to sheep and the contrasting vegetation types on the site will require different levels of grazing in order to achieve favourable condition, which might require some manipulation of livestock movements (both sheep and cattle) to achieve.

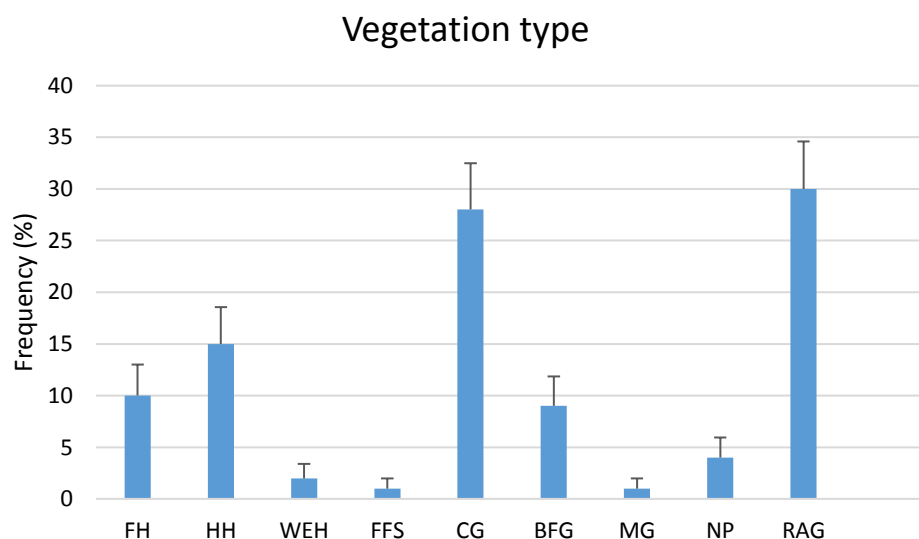


Figure 4. Frequency of vegetation types across the site in 2015. Bars are standard deviations. FH – fragmented heath; HH – heather heath; WEH – wet heath; FFS – flush, fen, & swamp; CG – calcareous grassland; BFG – bent-fescue grassland; MG – mesotrophic grassland; NP – non-productive; RAG – rough acid grassland.

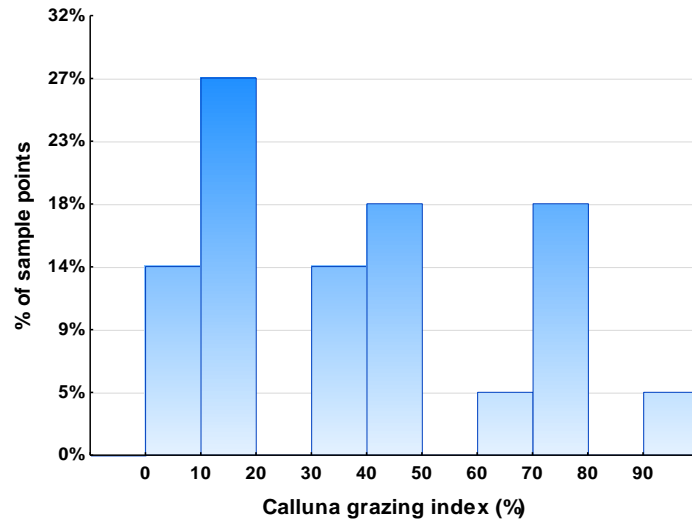


Figure 5. Frequency distribution of heather Grazing Index from sample points containing heather at whole site level in 2015.

Table 5. Heather Grazing Index at site level and by target vegetation type in 2015 (mean \pm standard deviation; n is number of sample points with heather stems).

	Overall ($n = 22$)	Heather Heath ($n = 14$)	Other* ($n = 8$)
Grazing Index	40.2 \pm 28.69	36.7 \pm 24.70	46.3 \pm 35.63
Samples \geq 33.3%	59.1%	57.1%	62.5%
Samples \geq 66.6%	22.7%	21.4%	25.0%

* calcareous grassland $n=1$; wet heath $n=2$; fragmented heath $n=5$

Table 6. Cover, height and detached stems in current (2015) and previous (2007) survey (mean \pm standard deviation; n is total number of sample points (covers, detached heather, detached vegetation), number of sample points containing heather or graminoids (heights)). Insufficient data on bilberry height to include in the analysis.

	2007			2015			$F_{1,42}$	P
	n	mean	st.dev.	n	mean	st.dev.		
Dwarf shrub cover	118	9.6	\pm 21.06	96	10.4	\pm 23.55	3.7	n.s.
Bilberry cover	118	0.0	\pm 0.08	96	0.1	\pm 0.39	1.8	n.s.
Heather cover	118	6.4	\pm 17.75	96	8.9	\pm 21.25	4.2	<0.05
Bare ground	118	0.2	\pm 1.90	96	0.5	\pm 1.91	0.2	n.s.
Heather height	26	13.8	\pm 6.28	22	18.8	\pm 9.79	2.6	n.s.
Graminoid height	114	8.2	\pm 3.73	96	13.5	\pm 5.33	10.1	<0.01
Detached heather	74	0.1	\pm 0.47	96	0.1	\pm 0.45	0.0	n.s.
Detached vegetation	83	0.4	\pm 1.13	96	0.4	\pm 0.87	2.5	n.s.
Overall							$F_{8,35}$	P
							3.0	<0.05

Table 7. Livestock droppings and heavily grazed features in current (2015) and previous (2007) surveys (presence, standard deviation and chi-square results; n is total number of sample points (droppings), number of sample points containing heather (heavily grazed features)). No burning data available for 2007.

	2007			2015			Chi-square	P
	n	presence	st.dev.	n	presence	st.dev.		
Livestock droppings	118	14	3.51	96	10	2.99	0.1	n.s.
Heavily grazed features	26	12	2.54	21	6	2.07	0.4	n.s.

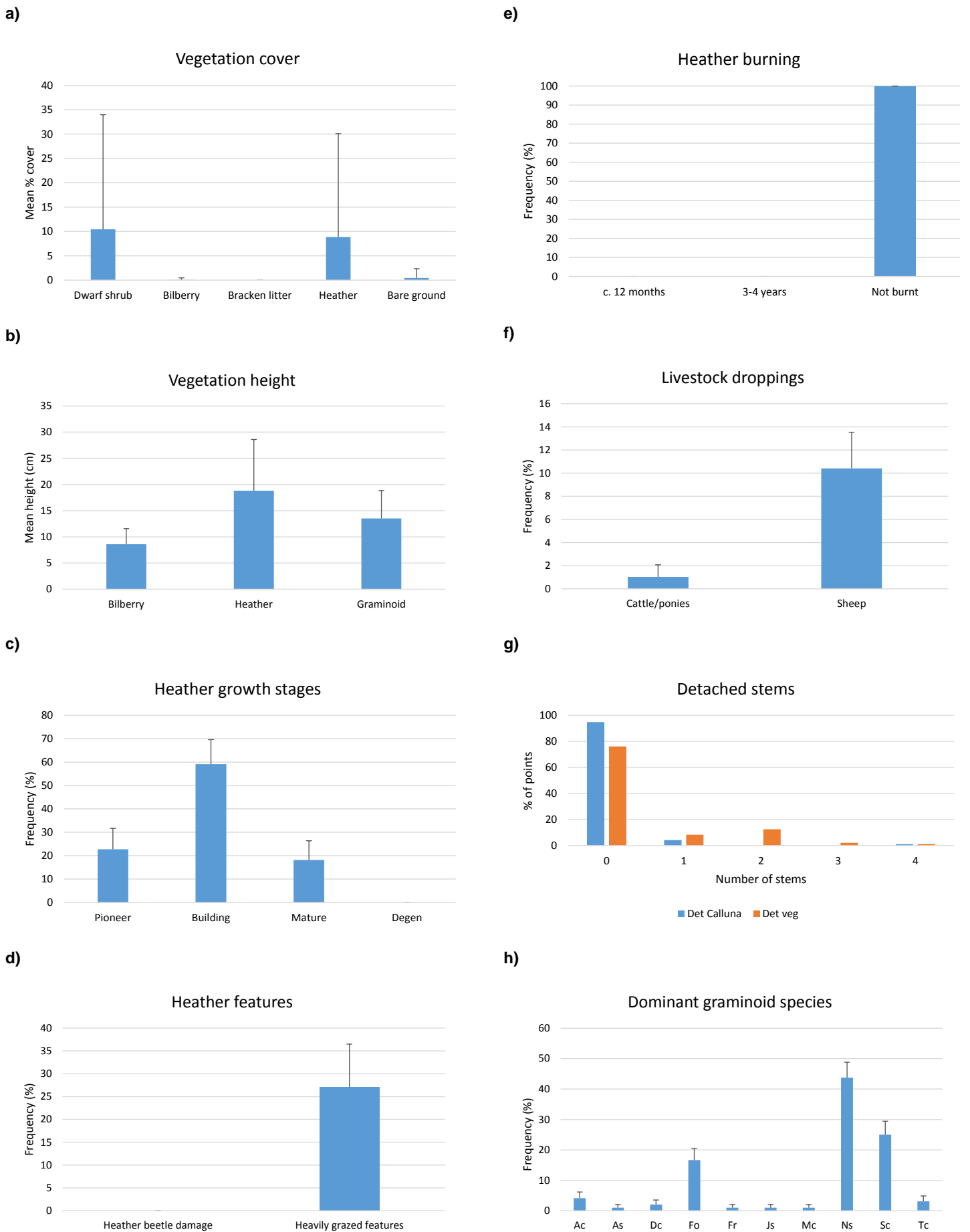


Figure 6. Surveillance variables at whole site level in 2015 (bars are standard deviations).

4.4 Overgrazing surveillance variables 2015

Category	Variable	Calcareous grassland (<i>n</i> = 28)			Heather Heath (<i>n</i> = 15)			Fragmented Heath (<i>n</i> = 10)		
		Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>
Peat	Peat depth (cm)	2	-	1	12	4.9	12	11	5.5	7
Vegetation cover	Dwarf shrub cover (%)	0	0.4	28	56	27.8	15	12	16.6	10
	Bilberry cover (%)	0	0.0	28	0	0.8	15	0	0.6	10
	Bracken litter cover (%)	0	0.0	28	0	0.0	15	0	0.0	10
	Calluna cover (%)	0	0.4	28	50	26.6	15	7	14.2	10
	Bare ground (%)	1	3.2	28	0	1.0	15	0	0.0	10
Vegetation height	Bilberry height (cm)	-	-	0	7	2.6	3	12	-	1
	Calluna height (cm)	11	-	1	20	9.8	14	21	9.2	5
	Graminoid height (cm)	11	4.2	28	13	4.8	15	18	3.9	10
Heather growth stages	Pioneer (% of points)	0	0.0	1	14	9.4	14	20	17.9	5
	Building (% of points)	100	0.0	1	57	13.2	14	80	17.9	5
	Mature (% of points)	0	0.0	1	29	12.1	14	0	0.0	5
	Degenerate (% of points)	0	0.0	1	0	0.0	14	0	0.0	5
Heather features	Heather beetle damage (% of points)	0	0.0	1	0	0.0	14	0	0.0	5
	Heavily grazed features (% of points)	0	0.0	1	29	12.1	14	20	17.9	5
Heather burning	Burnt (<i>c.</i> 12 months) (% of points)	0	0.0	1	0	0.0	14	0	0.0	5
	Burnt (3-4 years) (% of points)	0	0.0	1	0	0.0	14	0	0.0	5
Droppings	Cattle / ponies (% of points)	0	0.0	28	7	6.4	15	0	0.0	10
	Sheep (% of points)	14	6.6	28	13	8.8	15	0	0.0	10
Detached stems	Detached Calluna (no.)	0	0.2	28	0	1.0	15	0	0.3	10
	Detached vegetation (no.)	0	0.5	28	0	0.0	15	0	0.3	10

4.5 Habitat condition assessment results 2015

4.5.1 Dry heath

Targets assessed at habitat level in 2 x 2 m quadrat:

Dry heath (<i>n</i> =15 heather heath + 8 fragmented heath)		
Target	% of points passed	Habitat pass or fail
Presence of moss, liverworts and non-crustose lichens ¹	96	Pass
At least 50% of vegetation cover made up of Table 1 indicator species ²	43	Fail
At least 25% of dwarf shrub cover should be made up of Group (i) indicator species	100	Pass
Less than 50% of dwarf shrub cover made up of Group (ii) indicator species	100	Pass
At least two indicator species from Group (i)	83	Fail
Cover of weeds < 1%	100	Pass
Cover of soft rush < 10%	100	Pass
Dwarf shrub browsing < 33%	86	Fail
Disturbed bare ground < 10%	100	Pass

¹ assessed in 1 x 1 m quadrat

² assessed as total dwarf shrub cover, excluding dead and pioneer heather and recent burns

Targets assessed at feature extent:

Target	Pass or fail
Cover of non-native species < 1%	Pass
Cover of bracken < 10%	Pass
Cover of native trees/ shrubs < 20%	Pass
Cover of weeds < 1%	Pass
Cover of soft rush < 10%	Pass
Burning of sensitive areas absent	Pass
Disturbed bare ground < 10%	Pass
Mature heather ≥10% & all growth phases present	Fail

Indicator species frequencies (*n* = 23):

Species	Frequency (%)	SD
<i>Calluna vulgaris</i>	91	5.9
<i>Erica tetralix</i>	65	9.9
<i>Erica cinerea</i>	35	9.9
<i>Vaccinium myrtillus</i>	22	8.6
<i>Vaccinium oxycoccus</i>	0	0.0
<i>Vaccinium vitis-idaea</i>	0	0.0
<i>Empetrum nigrum</i>	4	4.3
<i>Racomitrium lanuginosum</i>	0	0.0
<i>Ulex gallii</i>	0	0.0
<i>Myrica gale</i>	0	0.0

4.5.2 Upland Calcareous Grassland

Targets assessed at habitat level in 1 x 1 m quadrat:

UCG (n=28)		
Target	% of points passed	Habitat pass or fail
At least 2 indicator species present	93	Pass
At least 33% cover of forbs or <i>Dryas octopetala</i>	0	Fail
Cover of <i>Bellis perennis</i> / <i>Ranunculus repens</i> < 25%	100	Pass
Less than 1% of vegetation cover to comprise of negative indicators	100	Pass
Cover of soft rush < 10%	100	Pass
At least 25% of tips of leaves/shoots should be > 5cm above ground	61	Fail
At least 25% of tips of leaves/shoots should be < 5cm above ground	39	Fail
At least half to be true: a) < 10% grass/sedge tillers uprooted; b) < 10% live leaves grazed for Aa/Ns/Pv/Sp/Tp ¹ ; c) < 50% live leaves legumes/ <i>P. lanceolata</i> grazed; d) < 66% live grass leaves grazed; e) < 25% broken/uprooted Hs/Ms/Sh/Ss/Sa ² ; f) > 50% <i>Dryas</i> shoots at least 3cm long	96	Pass
At least 50% <i>Dryas</i> leaves ≥ 1.5cm long.	N/A	N/A
< 10% cover dead plant litter thatch > 2cm in size	68	Fail
Disturbed bare ground < 10% cover (diffuse/scattered disturbance) ³	93	Pass

¹ Aa *Alchemilla alpina*, Ns *Nardus stricta*, Pv *Prunella vulgaris*, Sp *Sibbaldia procumbens*, Tp *Thymus polytrichus*

² Hs *Huperzia selago*, Ms *Minuartia seloides*, Sh *Saxifraga hypnoides*, Ss *Selaginella selaginoides*, Sa *Silene acaulis*

³ Assessed at 4 m² scale

Targets assessed at feature extent:

Target	Pass or fail
Cover non-native species < 1%	Pass
Cover of bracken and/or scattered native trees and scrub <10%	Pass
Cover native trees shrubs < 10%	Pass
Cover negative indicators < 1%	Pass
Cover soft rush < 10%	Pass
Disturbed bare ground < 10%	Pass

Indicator species frequencies ($n = 28$):

Species	Frequency (%)	SD	Species	Frequency (%)	SD
<i>Alchemilla alpina</i>	0	0.0	<i>Geum rivale</i>	0	0.0
<i>Alchemilla glabra</i>	0	0.0	<i>Helianthemum oelandicum</i>	0	0.0
<i>Angelica sylvestris</i>	0	0.0	<i>Helianthemum nummularium</i>	0	0.0
<i>Antennaria dioica</i>	0	0.0	<i>Hippocrepis comosa</i>	0	0.0
<i>Armeria maritima</i>	0	0.0	<i>Kobresia simpliciuscula</i>	0	0.0
<i>Asperula cynanchica</i>	0	0.0	<i>Koeleria macrantha</i>	4	3.5
<i>Briza media</i>	0	0.0	<i>Lathyrus linifolius</i>	0	0.0
<i>Campanula rotundifolia</i>	7	4.9	<i>Leontodon hispidus</i>	0	0.0
<i>Carex capillaris</i>	0	0.0	<i>Linum catharticum</i>	4	3.5
<i>Carex caryophylla</i>	0	0.0	<i>Lotus corniculatus</i>	0	0.0
<i>Carex flacca</i>	57	9.4	<i>Luzula spicata</i>	0	0.0
<i>Carex panicea</i>	7	4.9	<i>Myosotis alpestris</i>	0	0.0
<i>Carex pulicaris</i>	0	0.0	<i>Parnassia palustris</i>	0	0.0
<i>Carlina vulgaris</i>	0	0.0	<i>Persicaria vivipara</i>	0	0.0
<i>Cerastium fontanum</i>	11	5.8	<i>Pinguicula vulgaris</i>	0	0.0
<i>Cetraria islandica</i>	4	3.5	<i>Plantago maritima</i>	0	0.0
<i>Cochlearia alpina</i>	0	0.0	<i>Primula farinosa</i>	0	0.0
<i>Coelocaulon aculeatum</i>	0	0.0	<i>Sanguisorba minor</i>	0	0.0
<i>Danthonia decumbens</i>	0	0.0	<i>Saxifraga aizoides</i>	0	0.0
<i>Draba incana</i>	0	0.0	<i>Saxifraga hypnoides</i>	0	0.0
<i>Dryas octopetala</i>	0	0.0	<i>Scabiosa columbaria</i>	0	0.0
<i>Euphrasia</i> spp.	0	0.0	<i>Selaginella selaginoides</i>	0	0.0
<i>Filipendula ulmaria</i>	0	0.0	<i>Sesleria caerulea</i>	89	5.8
<i>Filipendula vulgaris</i>	0	0.0	<i>Stachys officinalis</i>	0	0.0
<i>Galium sternerii</i>	32	8.8	<i>Succisa pratensis</i>	0	0.0
<i>Galium verum</i>	0	0.0	<i>Thymus polytrichus</i>	82	7.2
<i>Gentiana verna</i>	0	0.0	<i>Veronica officinalis</i>	0	0.0
<i>Gentianella</i> spp.	0	0.0			

4.5.3 Wet heath

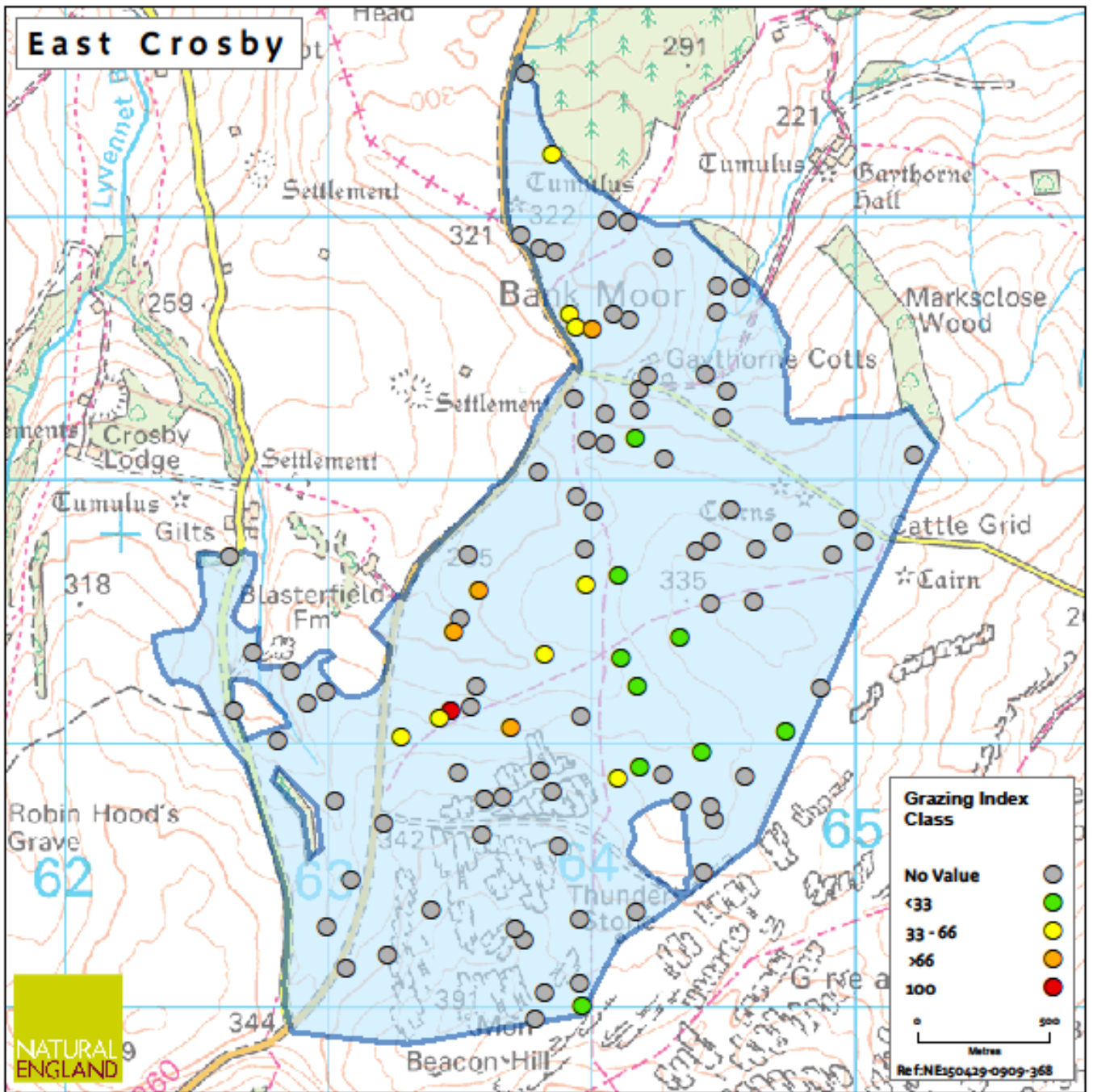
This habitat type was recorded at less than 10 sample points so condition cannot be accurately assessed at 2 x 2m quadrat level.

Targets assessed at feature extent:

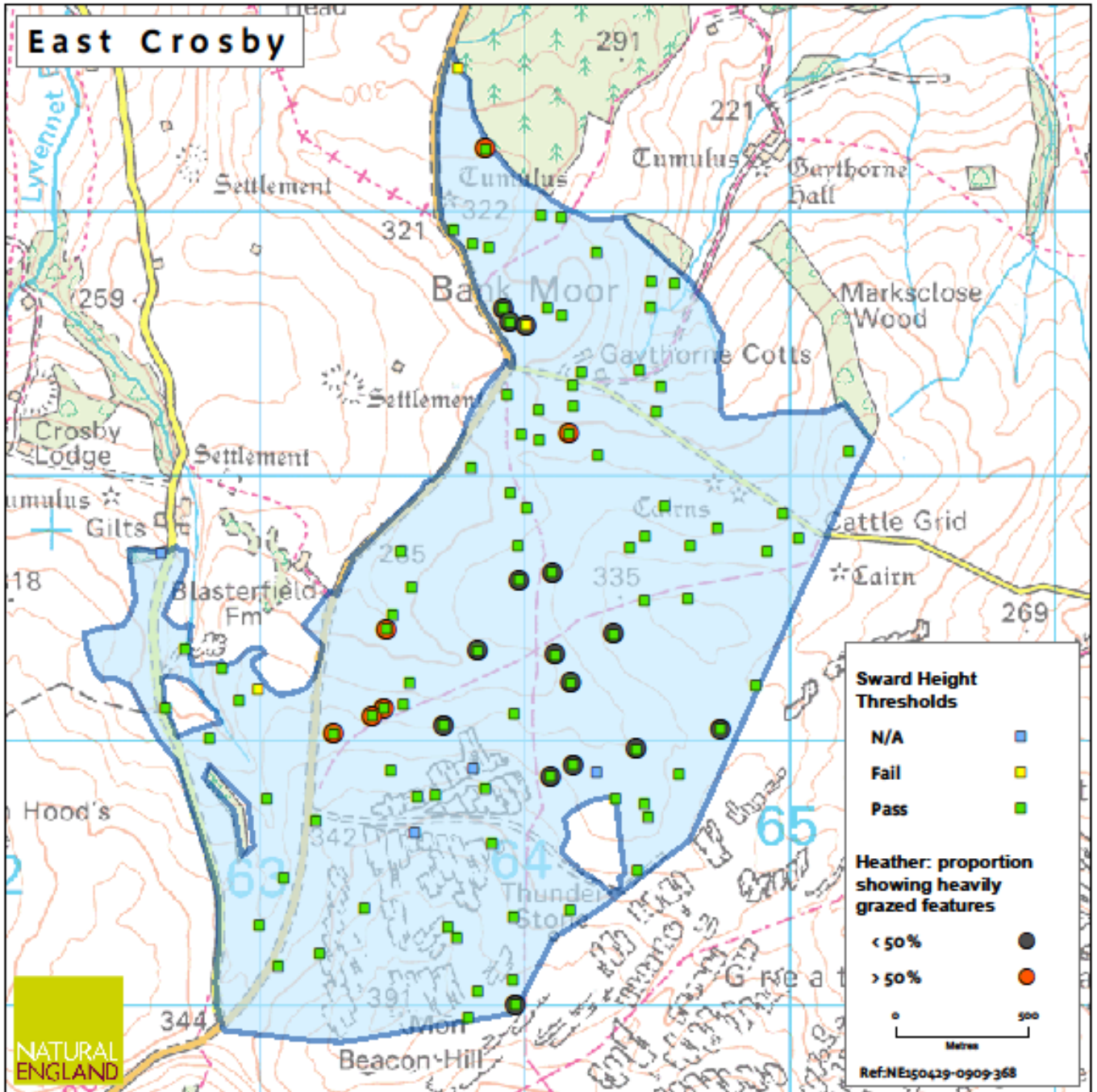
Target	Pass or fail
Cover of native trees/ shrubs < 20%	Pass
Cover of bracken < 10%	Pass
Cover of non-native species < 1%	Pass
Cover of negative indicators < 1%	Pass
Cover of soft rush < 10%	Pass
Burning of bryophyte layer absent	Pass
Burning of sensitive areas absent	Pass
Active drainage < 10%	Pass
Disturbed bare ground < 10%	Pass

Mires

This habitat type was recorded at only 1 sample point so condition cannot be accurately assessed at 2 x 2m quadrat level or feature extent.



Map 3: Distribution of random sampling points on Crosby Ravensworth Fell (east) in 2015, showing those where heather was present, along with heather grazing index (GI) class, derived from collected heather shoots.



Map 4: Distribution of sample points on Crosby Ravensworth Fell (east) in 2015, showing those which fall above (pass) or below (fail) habitat-related height thresholds indicative of heavy grazing, and with more or less than 50% of heather cover showing suppressed growth features.

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