

## Burnmoor

### 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](#)

The Burnmoor site was re-surveyed during 19 – 20 March 2014. Results of the survey are presented in a standard format in the following sections. Management information (particularly grazing) is also summarised from reports provided by NE. 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.

### 2. Overview

#### 2.1 General description

Burnmoor is located in Forest of Bowland (Lancashire) and covers 537 ha. Much of the vegetation comprises heather heath (30% of sample points in 2014), which is managed by burning and mowing in blocks. As a consequence, the heather was predominantly in the building growth stage, but also with significant amounts of mature and pioneer stages (Figure 3c). There are some areas where heather is absent and bilberry is the dominant dwarf shrub species. Fragmented heath is also frequent on the site, most of which is derived from wet heath, in which heather is the dominant dwarf shrub in many areas. *Eriophorum angustifolium*, pleurocarpus mosses and *Sphagnum* were often the only positive indicators, with *Trichophorum germanicum* only occurring rarely. Some drainage was evident around the boundary of the site at its most westerly end. Blanket bog is generally fragmented and degraded, with the best examples characterised by the M19 *Calluna vulgaris* – *Eriophorum vaginatum* community. Blanket bog has been burnt on the higher ground near the south end of the site. On the lower ground, mires are often represented by flushes, generally M6 *Carex echinata* – *Sphagnum recurvum* / *auriculatum* mire.

There is also a large amount of rough acid grassland (26% of sample points) on the site. Across the site as a whole, a wide range of graminoids were the most commonly dominant species, including *Juncus squarrosus*, *Nardus stricta*, *Deschampsia flexuosa* and *Molinia caerulea* (Figure 3h).

## 2.2 Site management

The site was identified as an overgrazing case in 1994. In 1997, the total stocking rates from the ten graziers ranged from 2.6 ewes ha<sup>-1</sup> in September to just 0.1 ewes ha<sup>-1</sup> in April and November. This was slightly more than the grazing rights allowed at that time. The moor entered the Countryside Stewardship Scheme in 2001, when the stocking rate was c. 1.5 sheep ha<sup>-1</sup> in summer and half that rate in winter. Further reductions are thought to have been negotiated then, although it is not certain if they were implemented. The site entered Higher Level Stewardship in 2012, which specified a detailed stocking calendar with maximum overall grazing rate of 0.09 LU ha<sup>-1</sup> (equivalent to 1.1 ewes ha<sup>-1</sup>), and a minimum of 0.04 LU ha<sup>-1</sup> (0.5 ewes ha<sup>-1</sup>)<sup>1</sup>. Seasonal rates were 0.75 – 1.4 ewes + lambs ha<sup>-1</sup> in summer and 0 – 0.5 ewes + lambs ha<sup>-1</sup> in winter. It also required grazing for a minimum of four months including summer grazing, and shepherding to avoid localised damage.

Early surveys in 1994 and 1999 to confirm and monitor overgrazing followed the original English Nature Grazing Index (ENGI), as modified by ADAS, a structured but relatively subjective assessment focussing on heather. A more objective overgrazing survey in 2000 measured grazing pressure on dwarf shrub, deriving a heather grazing index (GI) from shoots collected in the field. The development of the Surveillance Survey 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. Other 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 has subsequently entered an agri-environment agreement. The more recent types of grazing assessment survey undertaken on Burnmoor are set out in Table 1.

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

Years	Survey type	Main variables	Sampling Strategy	Sample numbers
1994, 1999	Overgrazing, ENGI	Dwarf shrub cover, proportion showing suppressed growth	Index units, structured walk	11 units each with 25 stops
2000	Overgrazing	GI	grid	134
2004	Surveillance	GI, Sward heights	random	119

## 2.3 Condition and grazing pressure in 2014

There is evidence of high levels of grazing on the fragmented heath, with heavily grazed features and sheep droppings recorded at more than half of the sample points in this vegetation. The mean GI was quite high (27.4% overall; Table 2) with not much variation among the main target habitats. One third of samples with heather present did not meet the CSM GI target of less than 33%, above which level grazing is likely to be damaging (Figure 2, Table 2, Map 1). These points were generally found on the northern slopes of the fell, and a small concentration near the summit of Burnmoor. Heavily grazed features were less in evidence in heather heath compared to fragmented heath, and present in 19% of points with heather overall (Figure 3d, Map 2), despite sheep droppings being

<sup>1</sup> Note that LU equivalents have varied among different schemes

present at half of the sample points (Figure 3f). These growth forms similarly occurred on the lower northern slopes. Some detached heather here was probably attributable to the mowing management of mature heather rather than sheep grazing. The mean graminoid sward height at 12% of sample points indicated that heavy grazing was likely in these areas, generally on the lower slopes but also around the summit of the moor (Map 2).

In the heather heath vegetation type, burning had been done in the last 3-4 years at over one third of sample points. However, none was recorded in the previous 12 months, nor was any recent burning recorded in fragmented heath or blanket bog. The frequency burns of different ages for the moor as a whole in 2014 is given in Figure 3e.

Heather beetle damage was widespread throughout the site and locally abundant (Figure 3d).

All three habitats (dry heath, wet heath and mires) failed to reach condition assessment thresholds (targets to be passed at 90% of sample points) for levels of browsing on dwarf shrubs. The dry heath habitat also failed to reach the thresholds for cover and diversity of indicator species, where the measure of dwarf shrub cover is taken as indicator species cover, a reasonable assumption for Burnmoor as no *Racomitrium lanuginosum* was recorded. Wet heath habitat also failed for several attributes relating to species composition. These results are not surprising since many of the fragmented heath samples were included within the condition assessment for these habitats. Mires habitats were also below thresholds relating to species composition, but also for burning in the bryophyte layer. Overall, the habitats are not in good condition, which is attributable to current levels of grazing or browsing, burning and damage from heather beetle.

#### 2.4 Change since previous surveys

The early ENGI surveys identified an overgrazing problem and likely deterioration in heather condition between 1994 and 1999. A survey carried out in 2000 concluded that the site overall was significantly overgrazed, with up to one third very heavily grazed. A subsequent survey in 2004 concluded that there had been no improvement in the condition of heather, nor a reduction in grazing pressure on the site since 2000. The 2004 survey used a similar sampling method to the current 2014 re-survey. The mean grazing index was lower in 2014 (27.4%) compared to 2004 (40.2%) although this is just outside the limits of statistical significance ( $F_{1,74} = 2.98$ ,  $P = 0.09$ ). However, taking into account the main variables of covers, heights and detached vegetation, there has been a significant overall change between 2004 and 2014 (Table 3). There have been small but significant increases in height of heather and in cover and height of bilberry, and a significant reduction in the amount of detached heather. There has also been a significant decline in the frequency of heavily grazed features but an increase in frequency of sheep droppings (Table 4). No change was detected in the frequency of recent burning.

Changes between 2004 and 2014 indicate that there has been a reduction in grazing intensity on the site during that period, with a corresponding response in the vegetation structure. However, these changes were relatively small, and the grazing intensity was still higher than the optimum for achieving good condition (*cf.* browsing levels on dwarf shrubs in both dry and wet heath). Given the high levels of grazing in the past, it will probably take a considerable number of years for major changes to occur, even under the HLS grazing prescriptions. The recent agri-environment scheme agreement does appear to be causing changes in the desired direction, but further reductions in grazing intensity are probably needed.

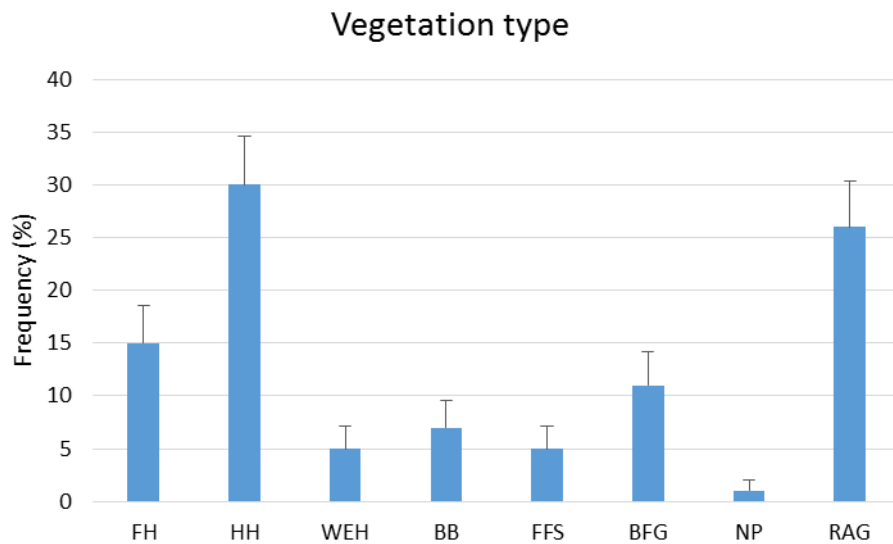


Figure 1. Frequency of vegetation types across the site in 2014. Bars are standard deviations. FH – fragmented heath; HH – heather heath; WEH – wet heath; BB – blanket bog; FFS – flush, fen, & swamp; BFG – bent-fescue grassland; NP – non-productive; RAG – rough acid grassland.

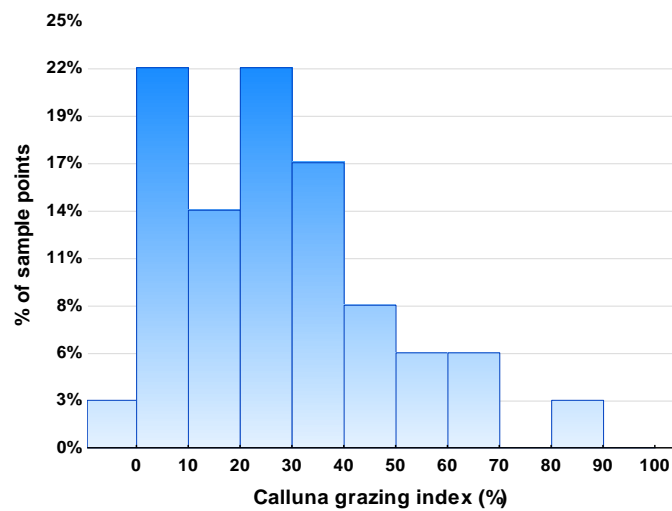


Figure 2. Frequency distribution of heather Grazing Index from sample points containing heather at whole site level in 2014.

Table 2. Heather Grazing Index in current (2014) and previous (2004) surveys (mean  $\pm$  standard deviation;  $n$  is number of sample points with heather stems).

	2004		2014		
	Overall ( $n = 40$ )	Overall <sup>1</sup> ( $n = 36$ )	Fragmented Heath ( $n = 3$ )	Heather Heath ( $n = 24$ )	Other <sup>2</sup> ( $n = 8$ )
Grazing Index	40.2 $\pm$ 35.58	27.4 $\pm$ 19.95	28.4 $\pm$ 12.84	26.5 $\pm$ 21.39	28.1 $\pm$ 20.30
Samples $\geq 33.3\%$	52.5%	33.3%	33.3%	29.2%	37.5%
Samples $\geq 66.6\%$	25.0%	2.8%	0.0%	4.2%	0.0%

<sup>1</sup> non-target habitat ( $n = 1$ )

<sup>2</sup> wet heath ( $n = 4$ ), blanket bog ( $n = 4$ )

Table 3. Cover, height and detached stems in current (2014) and previous (2004) surveys (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)).

	2004			2014			$F_{1,43}$	$P$
	$n$	mean	st.dev.	$n$	mean	st.dev		
Dwarf shrub cover	110	28.3	$\pm$ 37.71	99	15.7	$\pm$ 28.52	0.0	n.s.
Bilberry cover	110	5.7	$\pm$ 13.00	99	6.0	$\pm$ 9.36	5.4	<0.05
Heather cover	110	20.9	$\pm$ 37.33	99	13.6	$\pm$ 27.04	0.2	n.s.
Bare ground	110	2.2	$\pm$ 13.81	99	0.2	$\pm$ 1.09	0.7	n.s.
Bilberry height	61	8.6	$\pm$ 5.11	62	9.9	$\pm$ 6.00	5.6	<0.05
Heather height	40	21.7	$\pm$ 15.04	36	25.3	$\pm$ 13.65	5.1	<0.05
Graminoid height	94	10.1	$\pm$ 5.07	96	10.9	$\pm$ 5.89	2.4	n.s.
Detached heather	110	0.8	$\pm$ 2.62	99	0.2	$\pm$ 0.50	5.5	<0.05
Detached vegetation	110	0.2	$\pm$ 0.96	99	0.2	$\pm$ 0.65	2.0	n.s.
Overall							$F_{9,35}$	$P$
							3.7	<0.01

Table 4. Livestock droppings, burning and heavily grazed features in current (2014) and previous (2004) 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, burning)).

	2004			2014			$Chi$ - $square$	$P$
	$n$	presence	st.dev.	$n$	presence	st.dev		
Livestock droppings	120	40	5.16	99	54	4.95	10.0	<0.01
Heavily grazed features	33	19	2.84	36	7	2.37	9.1 *	<0.01
Burning	37	6	2.24	22 <sup>1</sup>	8	2.26	2.1 *	n.s.

\* Yates corrected chi-square

<sup>1</sup> includes some missing data

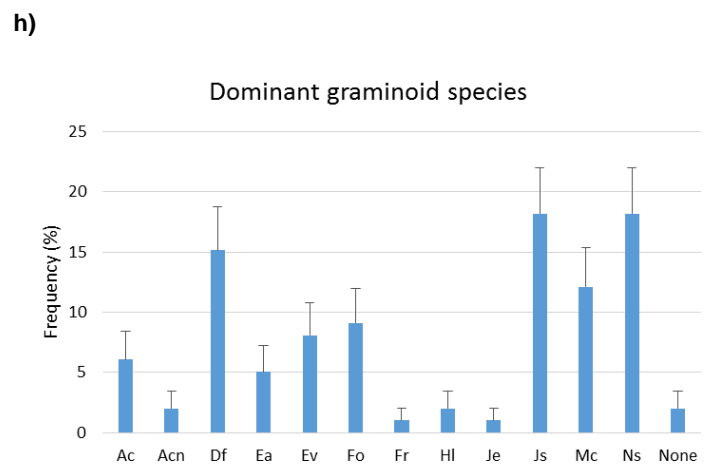
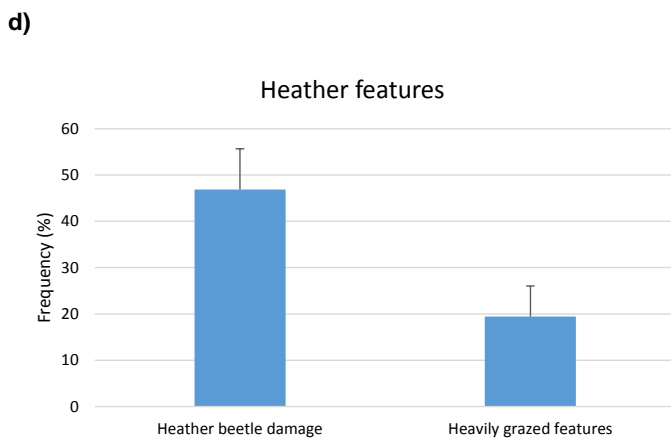
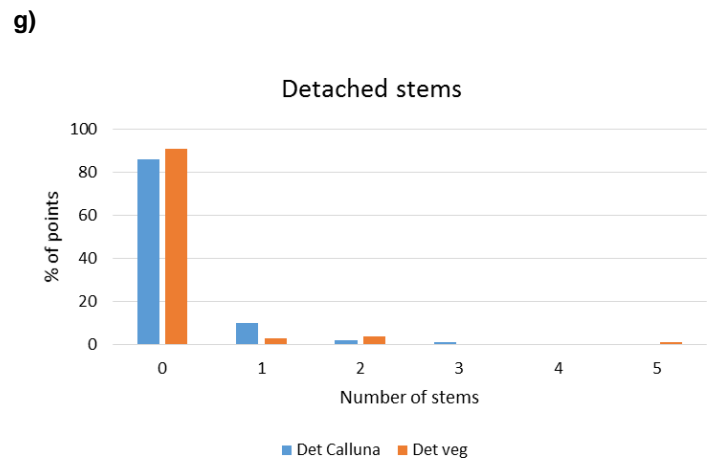
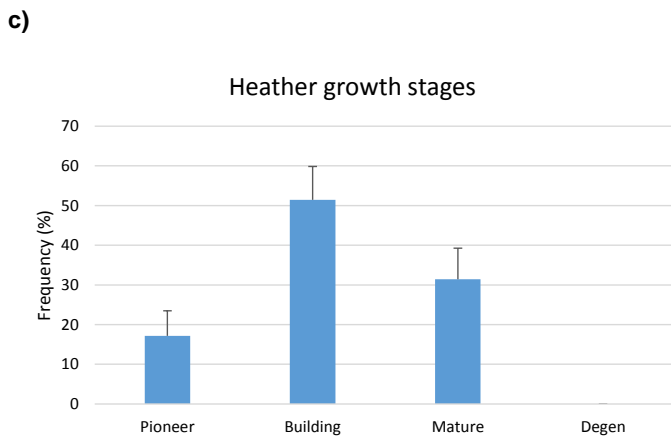
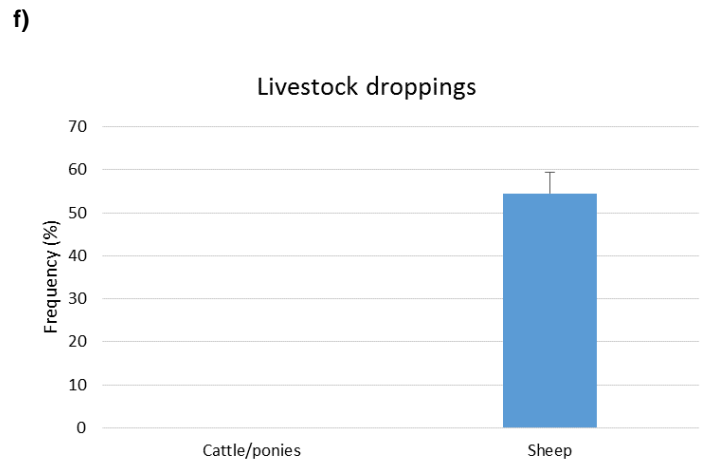
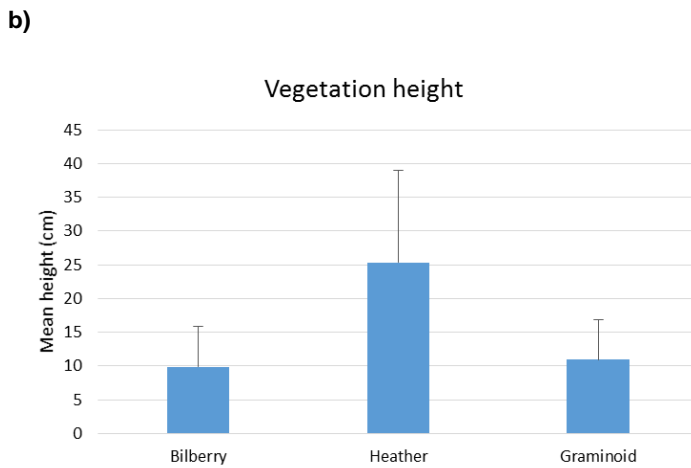
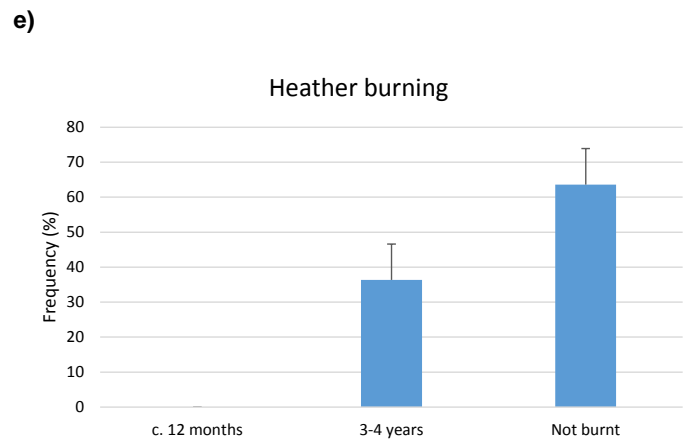
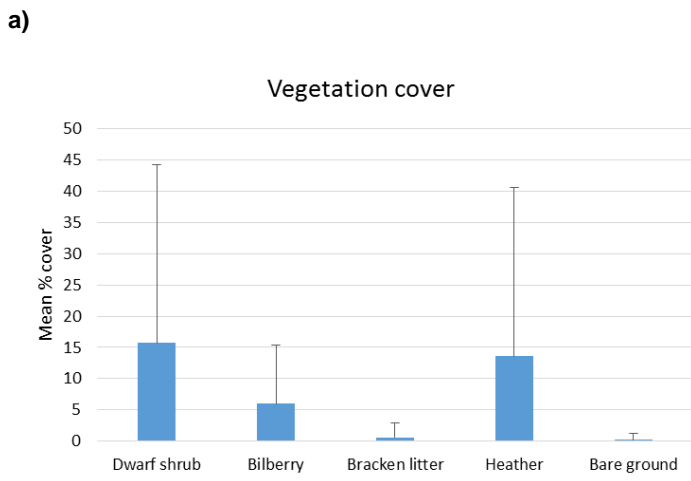


Figure 3. Surveillance variables at whole site level in 2014 (bars are standard deviations).

### 3. Overgrazing surveillance variables 2014

Category	Variable	Fragmented Heath ( <i>n</i> = 15)			Heather Heath ( <i>n</i> = 30)			Other Target Types* ( <i>n</i> = 17)		
		Mean	SD	<i>n</i>	Mean	SD	<i>n</i>	Mean	SD	<i>n</i>
Peat	Peat depth (cm)	25	13.7	14	21	12.2	28	47	23.3	17
Vegetation cover	Dwarf shrub cover (%)	2	3.6	15	44	35.6	30	12	20.0	17
	Bilberry cover (%)	7	8.7	15	11	11.8	30	6	10.8	17
	Bracken litter cover (%)	0	0.0	15	0	0.9	30	0	0.0	17
	Calluna cover (%)	1	2.8	15	40	36.3	30	8	14.6	17
	Bare ground (%)	0	0.0	15	0	0.0	30	0	0.8	17
Vegetation height	Bilberry height (cm)	10	5.4	10	11	5.0	29	13	12.6	7
	Calluna height (cm)	14	1.2	3	26	11.8	24	30	17.7	8
	Graminoid height (cm)	8	2.7	15	10	6.5	27	14	6.2	17
Heather growth stages	Pioneer (% of points)	0	0.0	2	17	7.6	24	13	11.7	8
	Building (% of points)	100	0.0	2	46	10.2	24	63	17.1	8
	Mature (% of points)	0	0.0	2	38	9.9	24	25	15.3	8
	Degenerate (% of points)	0	0.0	2	0	0.0	24	0	0.0	8
Heather features	Heather beetle damage (% of points)	0	0.0	3	50	10.7	22	50	17.7	8
	Heavily grazed features (% of points)	67	27.2	3	8	5.6	24	38	17.1	8
Heather burning	Burnt (c. 12 months) (% of points)	0	0.0	3	0	0.0	17	0	0.0	4
	Burnt (3-4 years) (% of points)	0	0.0	3	35	11.6	17	25	21.7	4
Droppings	Cattle / ponies (% of points)	0	0.0	15	0	0.0	30	0	0.0	17
	Sheep (% of points)	67	12.2	15	50	9.1	30	18	9.2	17
Detached stems	Detached Calluna (no.)	0.1	0.4	15	0.4	0.7	30	0.2	0.6	17
	Detached vegetation (no.)	0.1	0.5	15	0.2	0.6	30	0.1	0.2	17

\* Other target types = Wet heath (*n*=5); Blanket Bog (*n*=7); and Flushes, fens & swamps (*n*=5)

## 4. Habitat condition assessment results 2014

### 4.1 Dry heath

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

<b>Dry heath (n=30 heather heath + 7 fragmented heath)</b>		
Target	% of points passed	Habitat pass or fail
Presence of moss, liverworts and non-crustose lichens <sup>1</sup>	100	Pass
At least 50% of vegetation cover made up of Table 1 indicator species <sup>2</sup>	46	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)	84	Fail
Cover of weeds < 1%	100	Pass
Cover of soft rush < 10%	100	Pass
Dwarf shrub browsing < 33%	81	Fail
Disturbed bare ground < 10%	100	Pass

<sup>1</sup> assessed in 1 x 1 m quadrat

<sup>2</sup> 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 = 37):

Species	Frequency (%)	SD
<i>Calluna vulgaris</i>	86	5.6
<i>Erica tetralix</i>	5	3.7
<i>Erica cinerea</i>	0	0.0
<i>Vaccinium myrtillus</i>	97	2.7
<i>Vaccinium oxycoccus</i>	0	0.0
<i>Vaccinium vitis-idaea</i>	0	0.0
<i>Empetrum nigrum</i>	22	6.8
<i>Racomitrium lanuginosum</i>	0	0.0
<i>Ulex gallii</i>	0	0.0
<i>Myrica gale</i>	0	0.0



## 4.2 Wet heath

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

<b>Wet heath (n=5 wet heath + 8 fragmented heath)</b>		
Target	% of points passed	Habitat pass or fail
<i>Erica tetralix</i> present	69	Fail
At least 50% indicator species cover and 20% ericoid species	23	Fail
Cover of negative indicators < 1%	92	Pass
Cover of soft rush < 10%	85	Fail
Cover of dwarf shrubs ≤ 75% and graminoids ≤ 75%	92	Pass
Dwarf shrub browsing < 33%	85	Fail
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	Pass
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>	46	13.8	<i>Carex</i> spp.	15	10.0
<i>Erica tetralix</i>	46	13.8	<i>Rhynchospora alba</i>	0	0.0
<i>Erica cinerea</i>	0	0.0	<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.	92	7.4
<i>Myrica gale</i>	0	0.0	<i>Racomitrium lanuginosum</i>	0	0.0
<i>Andromeda polifolia</i>	0	0.0	Pleurocarpus mosses	92	7.4
<i>Eriophorum angustifolium</i>	46	13.8	Non-crustose lichens	0	0.0
<i>Trichophorum cespitosum</i>	0	0.0			

### 4.3 Mires

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

<b>Mires</b> (n=7 blanket bog + 5 flushes, fens & swamps)		
Target	% of points passed	Habitat pass or fail
At least 6 indicator species present	33	Fail
At least 50% of vegetation cover made up of at least 3 indicator species	42	Fail
<i>Sphagnum</i> cover should not consist of only <i>Sphagnum fallax</i>	100 <sup>1</sup>	Pass
Any one of <i>Eriophorum vaginatum</i> , Ericaceous spp. collectively or <i>Trichophorum</i> should not individually exceed 75% of veg cover	92	Pass
Less than 1% of vegetation cover to comprise of negative indicators	58	Fail
Dwarf shrub browsing < 33%	80 <sup>2</sup>	Fail
Disturbed bare ground/ drainage < 10%	100	Pass
Broken/ crushed <i>Sphagnum</i> < 10%	100	Pass

<sup>1</sup> n=11 (11 points with *Sphagnum* present)

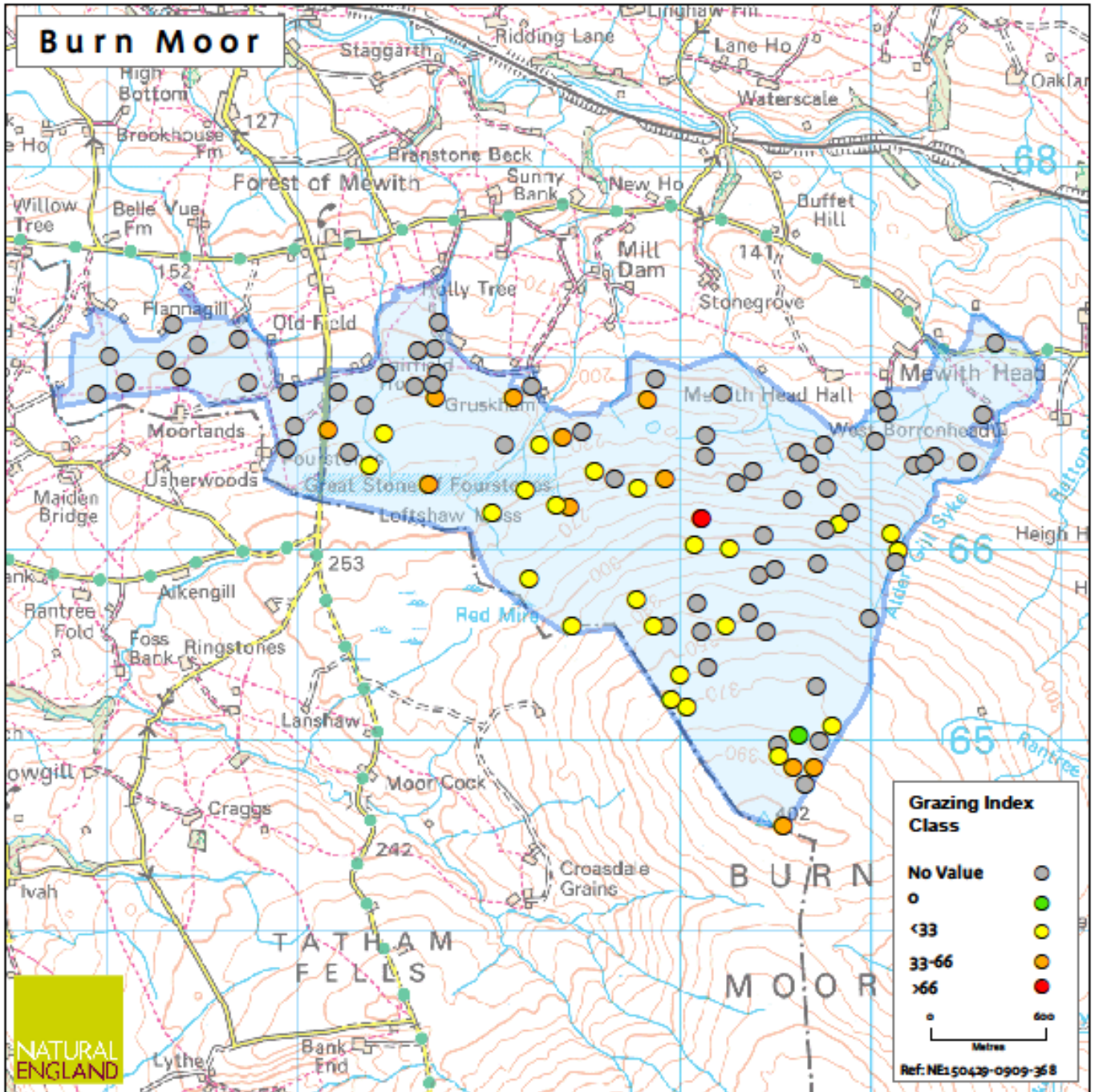
<sup>2</sup> n=10 (2 points with no information)

Targets assessed at feature extent:

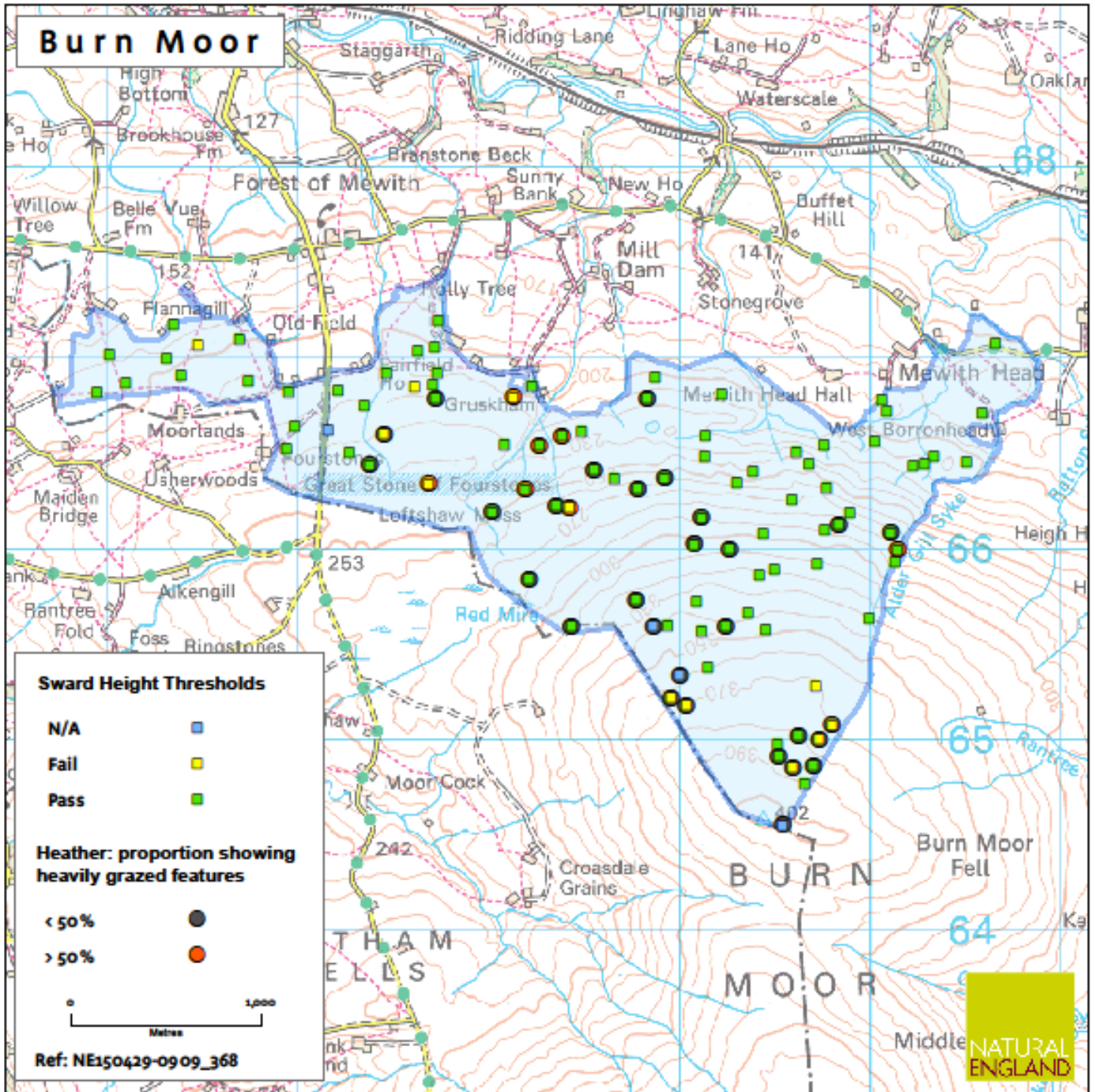
Target	Pass or fail
Cover of non-native species < 1%	Pass
Cover of native trees/ shrubs < 10%	Pass
Cover of negative indicators < 1%	Pass
Burning of bryophyte layer absent	Fail
Burning of sensitive areas absent	N/A
Extent of eroding peat	Pass
Disturbed bare ground < 10%	Pass

Indicator species frequencies (n = 12):

Species	Frequency (%)	SD	Species	Frequency (%)	SD
<i>Calluna vulgaris</i>	42	14.2	<i>E. vaginatum</i>	58	14.2
<i>Erica tetralix</i>	17	10.8	<i>Trichophorum cespitosum</i>	0	0.0
<i>Erica cinerea</i>	0	0.0	<i>Rhynchospora alba</i>	0	0.0
<i>Vaccinium myrtillus</i>	42	14.2	<i>Narthecium ossifragum</i>	0	0.0
<i>Vaccinium oxycoccus</i>	25	12.5	<i>Drosera</i> spp.	0	0.0
<i>Vaccinium vitis-idaea</i>	0	0.0	<i>Menyanthes trifoliata</i>	0	0.0
<i>Rubus chamaemorus</i>	0	0.0	<i>Sphagnum</i> spp.	92	8.0
<i>Empetrum nigrum</i>	25	12.5	<i>Racomitrium lanuginosum</i>	0	0.0
<i>Myrica gale</i>	0	0.0	Pleurocarpous mosses	100	0.0
<i>Andromeda polifolia</i>	0	0.0	Non-crustose lichens	0	0.0
<i>Eriophorum angustifolium</i>	42	14.2			



Map 1: Distribution of random sampling points on Burnmoor in 2014, 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 Burnmoor in 2014 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.

## Further information

Natural England evidence can be downloaded from our [Access to Evidence Catalogue](#). For more information about Natural England and our work see [Gov.UK](#). For any queries contact the Natural England Enquiry Service on 0300 060 3900 or e-mail [enquiries@naturalengland.org.uk](mailto:enquiries@naturalengland.org.uk) .

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