Ingleborough

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 Ingleborough site was surveyed during 29 – 30 April 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

Ingleborough is located in North Yorkshire and consists of two adjacent areas of common land, with an open shared boundary, covering 1500 ha. The site is coincident with Ingleborough SSSI and forms the majority of Ingleborough Complex SAC. Much of the vegetation on the site (41% of sample points in 2014; Figure 1) comprises rough acid grassland (U5 *Nardus stricta* grassland / U6 *Juncus squarrosus* grassland), especially on the steeper slopes, probably derived from heathland and blanket bog through historically high levels of grazing. This grades into degraded blanket bog on the more gentle slopes of Ingleborough Common and Clapham Ponts (29% of sample points), which largely comprises a form of grassy M20 *Eriophorum vaginatum* blanket mire. The bog vegetation is completely lacking any ericaceous component with *Sphagnum* no more than patchily abundant and has undoubtedly been affected by relatively high levels of grazing by sheep.

Calcareous grassland (mainly of the CG9 *Sesleria albicans - Galium sterneri* grassland type) is limited to patchy limestone scars and scree on lower slopes and to extensive flatter terraces with large areas of clint and grike pavement, sink holes and pot hole (11% of sample points). Much of it was relatively heavily (and preferentially) grazed by sheep with the vegetation closely cropped,

relatively species-poor and with grasses, rather than forbs, more prominent. The extent of better quality calcareous grassland is limited to small patches within limestone pavement and in lines on thin soils over limestone in mosaics with acid grassland. However, even here much has been modified through grazing and the effects of dunging into partly improved mesotrophic grassland.

No heather was recorded on the site and *Vaccinium myrtillus* cover was only 2% across the site (Figure 2a). The most commonly dominant graminoids across the site were *Nardus stricta*, *Juncus squarrosus* and *Eriophorum vaginatum*, associated with the large areas of rough acid grassland and degraded blanket mire (Figure 2e).

2.2 Site management

Following past concerns about overgrazing, the eleven graziers on the two commons were required to limit the number of sheep in accordance with their legal rights. This equated to an overall stocking rate of 2.0 sheep ha^{1}. In addition, grazing was prohibited from 5 November to 5 December and during the month of March and foddering on the site was not allowed except in emergencies. Many graziers did not put livestock onto the fell in the summer of 2001 due to the foot and mouth disease, and some graziers lost flock replacements that were wintered elsewhere, resulting in a short-term reduction in overall flock size. The site was entered into two Higher Level Stewardship (HLS) agreements in 2010, which specified stocking calendars of 0 – 0.3 sheep ha^{-1} December to mid-April and 0.5 – 0.9 sheep ha^{-1} mid-April to October, but excluding March and November when no stock were permitted[1].

Monitoring of the site commenced in 1994, when ten ADAS stands of 32 x1m^2 nested quadrats were established, stratified by grassland type (wet acid, dry acid and calcareous). These stands were permanently marked and revisited in 1995, 1996 and 1998. Since no heather was present on the site the heather grazing index (GI) methods typically used in overgrazing cases were not employed, and data was collected on sward heights and species composition, subsequently used to analyse change in "suites-species" scores. A more extensive survey took place in 2003 using Surveillance Survey methods, placing 196 quadrats on a grid covering the commons. Sward heights were measured at each point and compared to threshold heights for broad habitats as recorded in the field, below which a sample area is deemed to be heavily grazed. Other variables recorded included dwarf shrub heights, the presence of suppressed heather growth features, bare ground and animal droppings.

2.3 Condition and grazing pressure in 2014

Grazing levels on the blanket bog appeared to be only moderate in 2014. Although dwarf shrubs were scarce (limited to *Vaccinium myrtillis* at a mean cover of 2%), browsing on dwarf shrubs in blanket bog was only just below the condition assessment threshold (targets to be passed at 90% of sample points). No detached vegetation was recorded and sheep droppings were present at 17% of sample points. The failure to meet blanket bog thresholds for indicator species, including *Sphagnum* cover, is probably a legacy of past heavy grazing.

Grazing levels on calcareous grassland were higher than on blanket bog. Sheep droppings were present at just over one third of sample points, and 31% of points overall (Figure 2c) and detached vegetation was present at a small number (Figure 2d). The condition assessment target for the amount of vegetation over 5 cm tall was not met at 73% of points, which does suggest that grazing levels were higher than optimum. All other condition assessment thresholds were achieved, apart from the cover of forbs, reflecting an impoverished sward, probably due to previous high grazing intensity.

[1] Note that LU equivalents have varied among different schemes

The mean sward height at 9% of sample points indicated that heavy grazing was likely in these areas (Map 1), the majority (62%) on calcareous grassland. The sward height used to identify overgazing on calcareous grassland is more lenient than the CSM condition assessment target, at 3cm. Of the eleven calcareous grassland points, 45% fell below this threshold.

2.4 Change since previous surveys

Previous surveys of the site used a different sampling regime from that in 2014 so formal analysis of change is not possible. However, some general comparisons can be made. Surveys between 1994 and 2002 did not detect major changes in the vegetation, although there was a general decline in nutrient-suited species and an increase in acidity suited species. This was conjectured to be a combination of variation in weather and the continued influence of grazing. In 2003, the most commonly dominant graminoid species were the same as in the current survey, with frequencies for each species or group remarkably similar to the 2014 survey (e.g. *N. stricta* 28% in 2003 vs 27% in 2014; *J. squarrosus* 18% vs 24%; *E. vaginatum* 16% vs 19%), despite differences in the sampling methods used. Graminoid heights cannot be directly compared between these two surveys (mean sward heights of individual dominant graminoid species were measured in 2003, ranging from *Deschampsia flexuosa* (4.5 cm) to *Juncus effusus* (57.4 cm)) but the mean height of *V. myrtillus* was almost identical (6.3 cm in 2003 vs 6.5 cm in 2014).

The current grazing prescriptions appear to be relatively successful in reducing the grazing intensity on the site, compared to the historical levels. Grazing intensity on blanket bog is not particularly high. However, sheep appear to be preferentially grazing the calcareous grassland, to a level that is probably above the optimum intensity for that habitat. Despite the reduced stocking, both habitats are still impoverished in terms of their species composition. Burning does not appear to be an issue on this site, and the current condition of the vegetation is almost certainly a legacy of historically high grazing levels.

In the absence of stock fencing (which is probably not desirable) or relatively intensive shepherding (which is probably not practicable), management of this site to achieve favourable condition of all vegetation types will be very difficult, as upland calcareous grassland will always be preferentially grazed by sheep over rough acid grassland and degraded blanket mire. However, consideration could be given to the management of the extensive limestone scars occupying the north-west part of the site as a separate sub-compartment, although this would require the erection of stock fencing. More long-term targeted and stratified monitoring is probably required to build up a clearer picture of changes in vegetation on this large site.

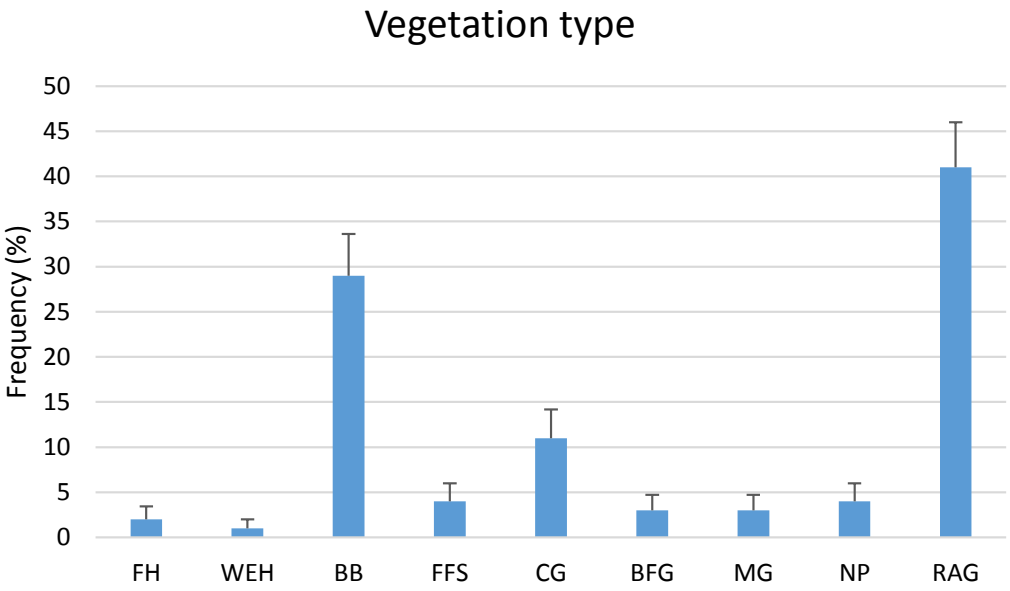
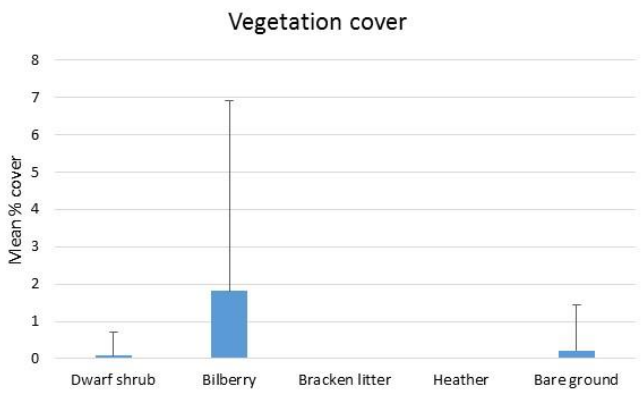


Figure 1. Frequency of vegetation types across the site in 2014. Bars are standard deviations. FH – fragmented heath; WEH – wet heath; BB – blanket bog; FFS – flush, fen, & swamp; CG – calcareous grassland; BFG – bent-fescue grassland; MG – mesotrophic grassland; NP – non-productive; RAG – rough acid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

a)



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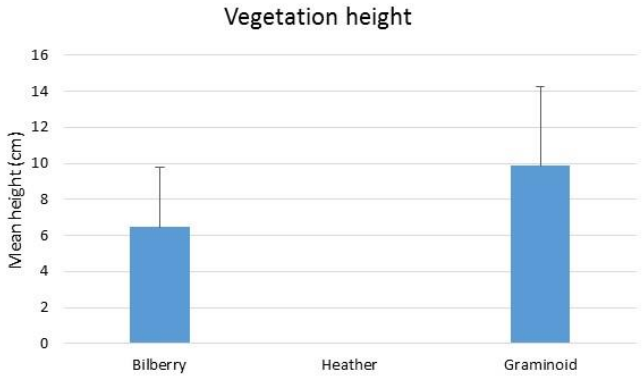

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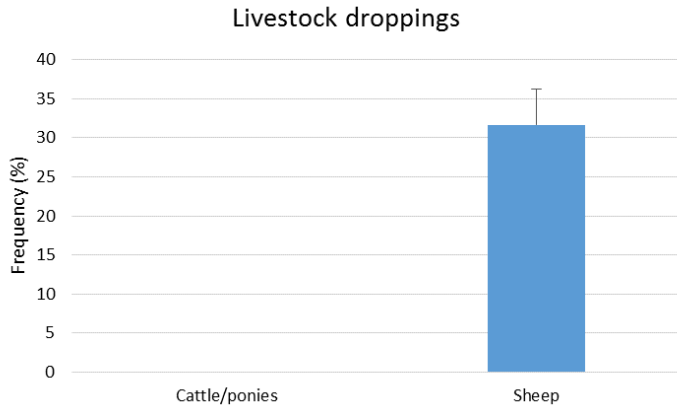

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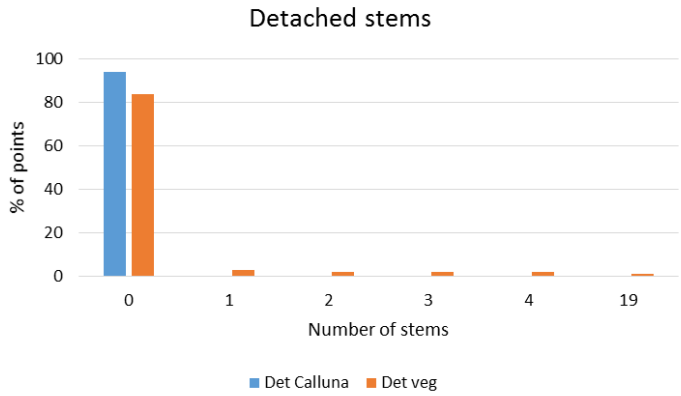

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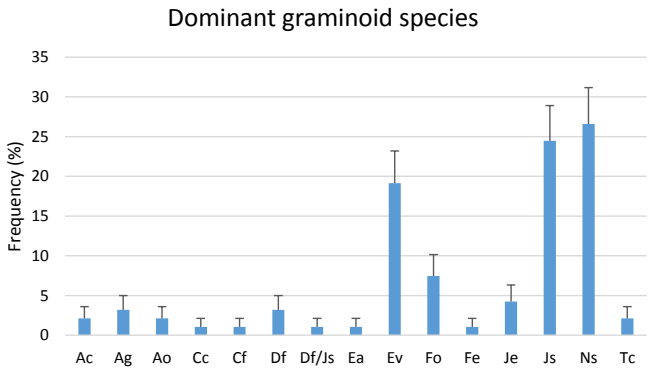


Figure 2. Surveillance variables at whole site level in 2014 (bars are standard deviations).

3. Overgrazing surveillance variables 2014

		Blanket Bog (*n* =29)			Calcareous Grassland (*n* = 11)		
Category	**Variable**	**Mean**	**SD**	***n***	**Mean**	**SD**	***n***
Peat	Peat depth (cm)	62	21.1	29	5	0.0	1
Vegetation cover	Dwarf shrub cover (%)	0	0.2	29	0	0.0	11
	Bilberry cover (%)	2	6.7	29	0	0.0	11
	Bracken litter cover (%)	0	0.0	29	0	0.0	11
	Calluna cover (%)	0	0.0	29	0	0.0	11
	Bare ground (%)	0	0.0	29	0	0.9	11
Vegetation height	Bilberry height (cm)	8	4.6	13	0	0.0	0
	Calluna height (cm)	0	0.0	0	0	0.0	0
	Graminoid height (cm)	13	3.8	29	3	1.5	11
Heather growth stages	Pioneer (% of points)	0	0.0	0	0	0.0	0
	Building (% of points)	0	0.0	0	0	0.0	0
	Mature (% of points)	0	0.0	0	0	0.0	0
	Degenerate (% of points)	0	0.0	0	0	0.0	0
Heather features	Heather beetle damage (% of points)	0	0.0	0	0	0.0	0
	Heavily grazed features (% of points)	0	0.0	0	0	0.0	0
Heather burning	Burnt (*c.* 12 months) (% of points)	0	0.0	0	0	0.0	0
	Burnt (3-4 years) (% of points)	0	0.0	0	0	0.0	0
Droppings	Cattle / ponies (% of points)	0	0.0	29	0	0.0	11
	Sheep (% of points)	17	7.0	29	36	14.5	11
Detached stems	Detached Calluna (no.)	0	0.0	29	0	0.0	11
	Detached vegetation (no.)	0	0.0	29	0.4	1.2	11

4. Habitat condition assessment results

4.1 Dry 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 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

4.2 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

4.3 Mires

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

Mires (*n*=29 blanket bog + 4 flushes, fens & swamps)		
Target	% of points passed	Habitat pass or fail
At least 6 indicator species present	9	Fail
At least 50% of vegetation cover made up of at least 3 indicator species	58	Fail
Sphagnum cover should not consist of only *Sphagnum* fallax	72[1]	Fail
Any one of *Eriophorum vaginatum*, Ericaceous spp. collectively, or *Trichophorum* should not individually exceed 75% of vegetation cover	94	Pass
Less than 1% of vegetation cover to comprise of negative indicators	97	Pass
Dwarf shrub browsing < 33%	88[2]	Fail
Disturbed bare ground/ drainage < 10%	97	Pass
Broken / crushed *Sphagnum* < 10%	100[3]	Pass

[1] *n*=25 (25 points with *Sphagnum* present)
[2] *n*=16 (17 points with no information)
[3] *n*=32 (1 point 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	Pass
Burning of sensitive areas absent	Pass
Extent of eroding peat	Pass
Disturbed bare ground < 10%	Pass

Indicator species frequencies (*n* = 33):

Species	**Frequency (%)**	**SD**		**Species**	**Frequency (%)**	**SD**
Calluna vulgaris	0	0.0		*E. vaginatum*	76	7.5
Erica tetralix	3	3.0		*Trichophorum cespitosum*	12	5.7
Erica cinerea	0	0.0		*Rhynchospora alba*	0	0.0
Vaccinium myrtillus	45	8.7		*Narthecium ossifragum*	6	4.2
Vaccinium oxycoccus	3	3.0		*Drosera* spp.	0	0.0
Vaccinium vitis-idaea	0	0.0		*Menyanthes trifoliata*	0	0.0
Rubus chamaemorus	0	0.0		*Sphagnum* spp.	76	7.5
Empetrum nigrum	0	0.0		*Racomitrium lanuginosum*	0	0.0
Myrica gale	0	0.0		Pleurocarpous mosses	79	7.1
Andromeda polifolia	0	0.0		Non-crustose lichens	0	0.0
Eriophorum angustifolium	58	8.6				

4.4 Upland Calcareous Grassland

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

UCG (*n*=11)		
Target	% of points passed	Habitat pass or fail
At least 2 indicator species present	100	Pass
At least 33% cover of forbs or *Dryas octopetala*	45	Fail
Cover of *Bellis perennis*/ *Ranunculus repens* < 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	27	Fail
At least 25% of tips of leaves/shoots should be < 5cm above ground	100	Pass
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/*P. lanceolata* grazed; d) < 66% live grass leaves grazed; e) < 25% broken/uprooted Hs/Ms/Sh/Ss/Sa[2]; f) > 50% *Dryas* shoots at least 3cm long	100	Pass
At least 50% *Dryas* leaves ≥ 1.5cm long.	n/a	n/a
< 10% cover dead plant litter thatch > 2cm in size	100	Pass
Disturbed bare ground < 10% cover (diffuse/scattered disturbance)[3]	100	Pass

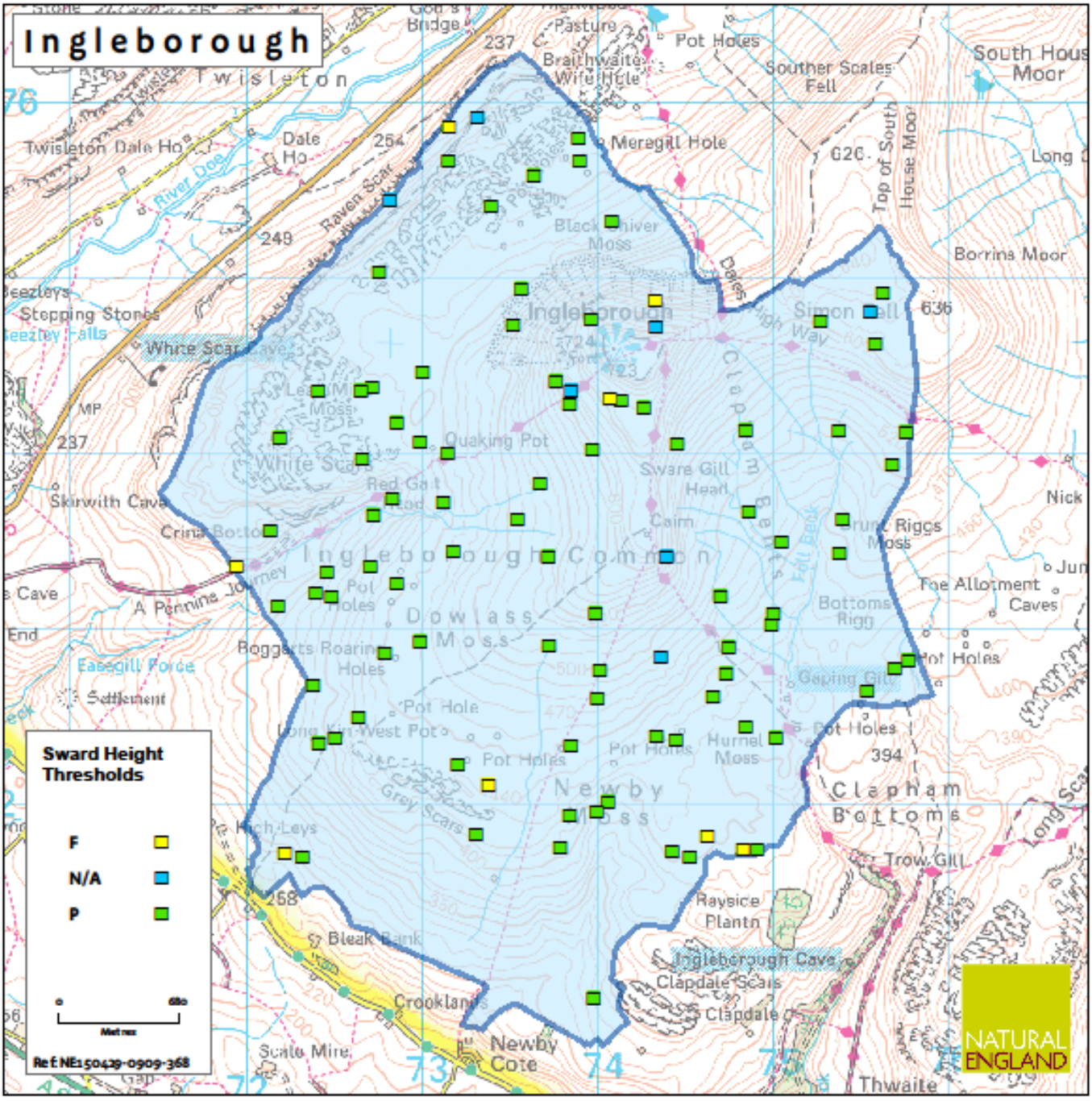
[1] Aa *Alchemilla alpina*, Ns *Nardus stricta*, Pv *Prunella vulgaris*, Sp *Sibbaldia procumbens*, Tp *Thymus polytrichus*
[2] Hs *Huperzia selago*, Ms *Minuartia seloides*, Sh *Saxifraga hypnoides*, Ss *Selaginella selaginoides*, Sa *Silene acaulis*
[3] Assessed at 4 m^2 scale

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* = 11):

Species	**Frequency (%)**	**SD**		**Species**	**Frequency (%)**	**SD**
Alchemilla alpina	0	0.0		*Geum rivale*	0	0.0
Alchemilla glabra	0	0.0		*Helianthemum oelandicum*	0	0.0
Angelica sylvestris	0	0.0		*Helianthemum nummularium*	0	0.0
Antennaria dioica	0	0.0		*Hippocrepis comosa*	0	0.0
Armeria maritima	0	0.0		*Kobresia simpliciuscula*	0	0.0
Asperula cynanchica	0	0.0		*Koeleria macrantha*	0	0.0
Briza media	27	13.4		*Lathyrus linifolius*	0	0.0
Campanula rotundifolia	82	11.6		*Leontodon hispidus*	0	0.0
Carex capillaris	0	0.0		*Linum catharticum*	9	8.7
Carex caryophyllea	82	11.6		*Lotus corniculatus*	27	13.4
Carex flacca	18	11.6		*Luzula spicata*	0	0.0
Carex panicea	0	0.0		*Myosotis alpestris*	0	0.0
Carex pulicaris	0	0.0		*Parnassia palustris*	0	0.0
Carlina vulgaris	0	0.0		*Persicaria vivipara*	0	0.0
Cerastium fontanum	36	14.5		*Pinguicula vulgaris*	0	0.0
Cetraria islandica	0	0.0		*Plantago maritima*	0	0.0
Cochlearia alpina	0	0.0		*Primula farinosa*	0	0.0
Coelocaulon aculeatum	0	0.0		*Sanguisorba minor*	9	8.7
Danthonia decumbens	0	0.0		*Saxifraga aizoides*	0	0.0
Draba incana	0	0.0		*Saxifraga hypnoides*	0	0.0
Dryas octopetala	0	0.0		*Scabiosa columbaria*	0	0.0
Euphrasia spp.	0	0.0		*Selaginella selaginoides*	0	0.0
Filipendula ulmaria	0	0.0		*Seslaria caerulea*	45	15.0
Filipendula vulgaris	0	0.0		*Stachys officinalis*	0	0.0
Galium sterneri	45	15.0		*Succisa pratensis*	0	0.0
Galium verum	0	0.0		*Thymus polytrichus*	100	0.0
Gentiana verna	0	0.0		*Veronica officinalis*	55	15.0
Gentianella spp.	0	0.0				



Map 1: Distribution of sample points on Ingleborough in 2014 showing those which fall above (pass) or below (fail) habitat-related height thresholds indicative of heavy grazing.

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** .

Report number RP01639 Number 9

ISBN 978-1-78354-393-9