

SCOTTISH
NATURAL
HERITAGE



A Guide to
**UPLAND
HABITATS**
Surveying
Land Management
Impacts

2

The Field Guide

A Guide
to
Upland Habitats
Surveying Land Management Impacts

Volume 2
The Field Guide

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Part 1: Guidance notes

Symbols and abbreviations

c.	Approximately
m²	Square metres
m⁻²	Per square metre
m⁻¹	Per metre (length)
10's m²	Tens of square metres <i>i.e.</i> an area between 10 m ² and 100 m ² . Similarly 100's m ² means an area within the range 100 m ² to 1000 m ² .
yr(s)	Year(s)
>	Greater than
>>	Much greater than
≥	Greater than or equal to
<	Less than
<<	Much less than
≤	Less than or equal to
sp.	Species (singular)
spp.	Species (plural)
... H	High impact
... M	Moderate impact
... L	Low impact
... C	Chronic impact
... D	Decreasing impact
... I	Increasing impact
... S	Stable
... M L	Indicator cannot discriminate between moderate and low impact. Other combinations of H , M and L should be interpreted similarly.
AND	Joins two separate features which must <i>both</i> be present for the indicator description to be applicable. Most often used in Trend Indicators. In some cases you may find that the descriptions seem to read more naturally if you substitute “but” for “and”.

Suggested abbreviations for mapping unimpacted areas

NG	Not grazed and/or not browsed
NT	Not trampled
ND	Not dried or drained
NB	Not burnt
NI	Not agriculturally improved

Standard descriptive terms for impact classes

Habitat	Impact	H	M	L
Smooth grassland	Grazing	Heavily grazed	Moderately grazed	Lightly grazed
	Agricultural improvement	Heavily modified		Little modified
Flush	Grazing and trampling	Heavily grazed /trampled	Moderately grazed /trampled	Lightly grazed /trampled
Tall herbs	Grazing	Heavily grazed	Moderately grazed	Lightly grazed
Scrub	Browsing, grazing and trampling	Heavily browsed /grazed /trampled	Moderately browsed /grazed /trampled	Lightly browsed /grazed /trampled
	Burning: intensity of impact	High intensity (heavily burnt)	Moderate intensity (moderately burnt)	Low intensity (lightly burnt)
	Burning: frequency of fires	High frequency fires (frequently burnt)	Moderate frequency fires (moderately frequently burnt)	Low frequency fires (infrequently burnt)
Blanket bog	Drying and peat loss	Heavily dried /disturbed	Moderately dried /disturbed	Lightly dried /disturbed
	Burning: intensity of impact	High intensity (heavily burnt)	Moderate intensity (moderately burnt)	Low intensity (lightly burnt)
	Burning: frequency of fires	High frequency fires (frequently burnt)	Moderate frequency fires (moderately frequently burnt)	Low frequency fires (infrequently burnt)

Standard descriptive terms for impact classes

Habitat	Impact	H	M	L
Wind-clipped summit heath	Trampling and grazing	Heavily trampled /grazed	Moderately trampled /grazed	Lightly trampled /grazed
	Grazing and trampling	Heavily grazed /trampled		Lightly grazed /trampled
	Burning	Heavily burnt		Unburnt
Dwarf-shrub heath	Browsing	Heavily browsed	Moderately browsed	Lightly browsed
	Burning: intensity of impact	High intensity (heavily burnt)	Moderate intensity (moderately burnt)	Low intensity (lightly burnt)
	Burning: frequency of fires	High frequency fires (frequently burnt)	Moderate frequency fires (moderately frequently burnt)	Low frequency fires (infrequently burnt)
Tussock grassland	Grazing	Heavily grazed	Moderately grazed	Lightly grazed
	Burning: intensity of impact	High intensity (heavily burnt)	Moderate intensity (moderately burnt)	Low intensity (lightly burnt)
	Burning: frequency of fires	High frequency fires (frequently burnt)	Moderate frequency fires (moderately frequently burnt)	Low frequency fires (infrequently burnt)
Bracken	Vigour	High vigour	Moderate vigour	Low vigour

Key to habitats

Notes

- The Glossary should be consulted if the meaning of any of the terms used is unclear.
- Where two habitat types are given the one in brackets represents a habitat which has been largely, but not completely, transformed into the other by impacts. Either or both habitat types can be used for assessment depending on which is more appropriate to site objectives.
- Some habitat types can overlay others so a particular area of ground may key out as more than one type of habitat. This particularly applies where bracken is involved.
- Tall forb species most commonly include one or more of following: *Alchemilla glabra*, *Angelica sylvestris*, *Geranium sylvaticum*, *Geum rivale*, *Heracleum sphondylium*, *Luzula sylvatica*, *Sedum rosea* and *Trollius europaeus*.

1a	Bracken predominant.	Bracken
1b	Not as above.	2
2a	Shrubs and/or dwarfed trees predominant, 1 m - 3 m - (5 m) tall.	Scrub
2b	Not as above.	3
3a	Short, prostrate mat of dwarf-shrubs, <i>Racomitrium lanuginosum</i> , lichens, or <i>Juncus trifidus</i> , or mixtures of these, < 10 cm tall. Many shoots of dwarf-shrubs and <i>Racomitrium</i> aligned approximately in the same direction.	Wind-clipped summit heath
3b	Not as above.	4
4a	On peat > 0.5 m deep (test by pushing in a bamboo cane or similar stick).	Blanket bog
4b	Not on peat, or peat < 0.5 m deep.	5
5a	<i>Sphagnum</i> bog mosses and/or <i>Eriophorum</i> spp. predominant.	Blanket bog

Key to habitats

5b	Not as above.	6
6a	Ground wet, watertable close to (or at) the surface.	7
6b	Ground dry, watertable not near the surface.	9
7a	Some flow of soil water at least near the surface. Small sedges, forbs and a variety of types of mosses often abundant.	Flush
7b	Little or no flow of soil water even very close to the surface.	8
8a	Dwarf-shrubs predominant.	Dwarf-shrub heath
8b	Graminoids predominant.	Tussock grassland
9a	Dwarf-shrubs predominant, 10 cm - 30 cm - (50 cm) tall (occasionally up to 100 cm).	Dwarf-shrub heath
9b	Graminoids predominant.	10
9c	Forbs predominant.	13
9d	Mosses or lichens predominant.	15
9e	None of the above.	Not covered by guide
10a	Tussocky graminoids predominant, 10 cm - 30 cm - (50 cm) tall (excluding flowering shoots).	11
10b	Non-tussocky graminoids and/or forbs predominant, 2 cm - 10 cm - (25 cm) tall.	12
11a	Dwarf-shrubs frequent but plants very small.	Tussock grassland (Dwarf-shrub heath)
11b	Tall forb species frequent but plants very small.	Tussock grassland (Tall herbs)
11c	Shrubs and trees frequent but plants very small.	Tussock grassland (Scrub)
11d	Not as above.	Tussock grassland

Key to habitats

- | | | |
|-----|---|--|
| 12a | Dwarf-shrubs frequent but plants very small. | Smooth
grassland
(Dwarf-
shrub
heath) |
| 12b | Tall forb species frequent but plants very small. | Smooth
grassland
(Tall herbs) |
| 12c | Shrubs and trees frequent but plants very small, or infrequent, scattered large plants. | Smooth
grassland
(Scrub) |
| 12d | Not as above. | Smooth
grassland |
| 13a | Forbs 25 cm - 50 cm tall (but may die down in winter). | Tall herbs |
| 13b | Forbs < 25 cm tall. | 14 |
| 14a | Tall forb species present, but plants very small. | Smooth
grassland
(Tall herbs) |
| 14b | Tall forb species absent. | Smooth
grassland |
| 15a | Dwarf-shrub plants present and > 10 cm tall, or if < 10 cm tall the plants are not prostrate and the shoots are not aligned in one direction. <i>Sphagnum</i> spp. and/or <i>Eriophorum</i> spp. scarce or absent. | Dwarf-
shrub heath |
| 15b | <i>Sphagnum</i> spp. and/or <i>Eriophorum</i> spp. frequent. <i>Sphagnum</i> may be bleached. | Blanket bog |
| 15c | Not as above. Varied mixture of small sedges, forbs and/or a variety of mosses. The mosses may form dominant cushions or mats. Even if dry, some evidence of water movement near the surface from small channels and/or sediment spread over the surface. | Flush |

Glossary

abundant	Found in large amounts. Usually also frequent and widespread.
baulk	As applied to bog, a strip or swathe of uncut peat remaining as a raised area after peat cutting operations.
bleached	As applied to mosses, particularly <i>Sphagnum</i> species and <i>Leucobryum glaucum</i> , this means a lack of natural colour. The plants are white or pale greyish-fawn. The structure of the plant usually remains intact, at least initially. Can be the result of fire or drought.
boreal climate	A climate which has dry, cold winters and relatively warm summers, relatively little affected by mild, moisture carrying Atlantic winds. True boreal climate occurs across Scandinavia and northern Eurasia but the climate in parts of north-east Scotland comes quite close to south western boreal in character.
bottle-brush moss	Mosses with a relatively upright, little branched growth form which is reminiscent of miniature conifer trees. <i>Polytrichum commune</i> is a very typical example. Usually acrocarpous mosses.
browsing	The removal of foliage and shoots of woody plants by larger herbivores.
bryophyte	Moss or liverwort.
bushy <i>Cladonia</i>	Species of <i>Cladonia</i> lichens with growth forms like miniature trees and bushes (arbuscular). Typical species are <i>Cladonia arbuscula</i> and <i>C. portentosa</i> .
canopy	This is a collective term for the entire assemblage of foliage and directly foliage-bearing shoots forming the upper surface of a plant or patch of vegetation.
carpet	As applied to dwarf-shrubs, this means a prostrate, mat-like growth form in which there is little successful upward growth of shoots, most surviving shoots and branches growing low to the ground with many creeping horizontally.
chronic	Occurring over a prolonged period of time.
conspicuous	Can be spotted immediately from a standing position from the majority of observation points within an assessment unit.
decimetre	10 cm.

Glossary

drumstick	As applied to dwarf-shrubs, this means a growth form with a small mass or ball of densely branched canopy, composed of short, contorted and intertwined shoots, on the end of a bare, often thick stem of variable length.
dung pellet group	An aggregation of more than 6 individual dung pellets.
dwarf-shrub	Much branched woody plant, with a typical maximum potential height of less than 1 m. Often much shorter, and sometimes only present as a prostrate mat. In the uplands many of dwarf-shrub species characteristically belong to the heath family (Ericaceae).
easily found	Found in less than 1 minute at the majority of observation points within an assessment unit.
epiphytic	Growing on the surface of plants, usually on the bark of stems or branches of woody plants.
extensive	Occurring widely over an assessment unit, being found in most parts of it. Usually also apparently abundant.
feather moss	Moss with much branched shoots, often very regularly (so giving the impression of “feathers”), which form loose, horizontally layered, mats. <i>Hylocomium splendens</i> and <i>Pleurozium schreberi</i> are typical examples. Usually pleurocarpous mosses.
field layer	The layer or stratum in the vegetation composed of herbaceous plants and dwarf-shrubs, usually less than 1 m tall.
forb	Any herb which is not a graminoid.
frequent	As applied to plants or other features, this means that they can be found in most parts of an assessment unit, though they may not necessarily appear to be abundant.
graminoid	Herbs which are grass-like in appearance and growth form. Includes plants belonging the grass family (Poaceae) and sedge family (Cyperaceae).
grazing	The removal of foliage and shoots of non-woody, herbaceous plants by herbivores.
grips	Moor grips. Refers to widely spaced shallow drains, mostly designed to remove surface water quickly, which can be widespread on moorland.
ground layer	The layer or stratum in the vegetation immediately above the soil surface composed of very short herbs, mosses, lichens and plant litter, usually less than 10 cm deep.

Glossary

herb	Any plant (excluding mosses, lichens and algae) without a woody stem or stems.
hummock	As applied to bogs this means a low mound, usually less than 0.5 m tall, formed largely from mosses, particularly <i>Sphagnum</i> species.
intensive searching	Involves searching for more than 1 minute at the majority of observation points in an assessment unit in order to find a particular feature.
layering	Applies to woody plants in which prostrate branches, in contact with the soil or buried by vigorous moss growth or litter accumulation, produce new roots at various points along their length. These may eventually come to replace the primary root system in supplying the plant with water and nutrients.
leaf turnover	The rate at which leaves die (or are cropped) and are replaced.
oceanic climate	Climate with low but not very variable temperatures and, usually, high humidity for much of the time. Usually also windy.
patchily	Not uniformly, irregularly.
plant litter	Accumulated dead plant material (mostly dead leaves).
poaching	A traditional term to describe the effects of heavy trampling by livestock, particularly on wet ground, in which a deeply pock-marked and churned surface is produced.
predominant	As applied to a plant species or feature, this means that it covers more than 50% of the ground area of the assessment unit.
rhizomatous	Bearing stems which grow more or less horizontally at or below the ground surface.
ridge	When applied to bogs this means the highest, and driest, ground on a natural, undulating bog surface. Formed of firm peat about 10 - 20 cm above the water table.
sapling	A young tree and shrub, usually at least 2 years old, and more than 25 cm tall.
scouring	Water erosion in which a flow of water cuts down into the substrate and deepens its channel.

Glossary

sheep scar	A usually crescent shaped break in the vegetation on steep slopes (the horns of the crescent pointing downhill) with a vertical back wall and a flat or sloping downhill step of bare, or possibly loose, soil or stones. Produced by sheep trampling and rubbing.
shrub	A much branched, woody plant, without a single main stem, with a typical maximum potential height between 1 m and 5 m.
stand	As applied to vegetation, this means an area of vegetation with the same impact history and similar vegetation composition (the two usually being related), usually forming a unit of vegetation which is easily definable in the field.
substantial	Not small, easily observed, conspicuous, not easily overlooked, affecting a large part of the feature concerned.
sucker	A new aerial stem arising from an underground stem or root.
sward	The surface of a herbaceous turf, usually grassy, and usually less than 10 cm tall.
tiller	A side shoot produced from the base of a plant.
topiary	As applied to dwarf-shrubs, shrubs and trees, this means plants of very compact, rounded, tabular or conical shapes, produced by prolonged heavy clipping of shoots by browsing animals. The plants are internally highly branched and have a dense but shallow canopy composed of tightly packed shoots and foliage. Intermediate between “carpet” and “drumstick” growth forms.
topographic exposure	The degree to which a location is <i>not</i> surrounded by higher, sheltering ground and thus the degree to which it is exposed to wind.
tussock	A dense, usually roughly hemispherical, mass of closely packed shoots and tillers, of grass or sedge. There is sometimes a hard, somewhat “woody” core.
vascular plant	A plant with internal water conducting vessels. A “higher” plant including ferns, clubmosses, and all herbs and woody plants. Excludes algae, lichens and bryophytes.

Glossary

- water track** A route taken by water draining naturally off an area, usually applied in bog situations. Similar to a flush but usually not spring-fed so the flow of water is only intermittent.
- weather-blasted** Damaged by extreme weather conditions, usually as a result of desiccation produced by strong winds, salt spray (near the coast) and/or dry, frosty conditions.
- winter
browning** A form of weather-blasting damage produced in winter, usually applied to dwarf-shrubs (particularly *Calluna vulgaris*).

Guidance notes

The use of indicators

- Remember that you should be looking for directly observable, current effects of impacts. (Only the trend indicators include features indicative of past impact.)
- Large-scale indicators are meant to be used from some distance away from the assessment unit, generally a distances between 100 m and 1 km. Some do require closer inspection of small areas but the results of this inspection indicate conditions over a much larger area.
- Small-scale indicators are meant to be used from within the assessment unit. They are mostly point estimates which describe a small patch of ground, of a square metre or less, immediately in front of the surveyor.
- Small-scale indicator point estimates should be made at ten sample points at least, well scattered across the polygon to ensure that a representative assessment is obtained. The results should be averaged for the whole assessment unit.
- Keep the results from large-scale field indicators (Phase 1 Impact Survey) separate from those from small-scale field indicators (Phase 2 Impact Survey).
- In indicator descriptions, “conspicuous” means that the feature can be spotted immediately from a standing position from the majority of observation points within the assessment unit, while “easy to find” means the feature can be found in less than 1 minute at the majority of observation points within an assessment unit.
- In a situation where the class descriptions of a field indicator seem too broad to exactly describe what is observed then choose whichever class is closest.
- Read the additional information indicated by *NB*. This will often indicate any exceptions and may help to clarify puzzling situations.

Guidance notes

- Not all indicators will be applicable in all parts of Scotland, at all sites or at all locations within a site.
- Use as many indicators as possible, as are applicable to the assessment unit. Do not rely on just one or two indicators.
- In deciding on the overall impact class for an assessment unit adopt the class closest to the average of the class results for all the indicators used.

Additional points to bear in mind

- Chronically heavily browsed shrubs, dwarf-shrubs, or tall herbs may be inconspicuous in the vegetation in which case it may not be immediately obvious that **Scrub**, **Dwarf-shrub heath**, or **Tall herbs** could be used in the assessment. Which of these *should* be used will depend on the management objectives of the site. Habitats are not necessarily mutually exclusive and an assessment for more than one habitat type for a given area of ground may be useful.
- The diffuse and fragmentary pattern of flushes can sometimes make it difficult to define the boundaries of patches which will form sensible assessment units. No definitive guidance can be given on this. All impact classes may occur within the same flush system. The best approach, probably, is to become familiar with the indicators for the different impact classes and to use these to assess or map how much of the system comes closest to which impact class. Sharp boundaries between impact classes should not necessarily be expected.
- Distinguishing the current season's shoot growth from older growth in woody plant species is relatively easy on trees and shrubs but can be difficult on dwarf-shrub species other than *Calluna vulgaris* and *Vaccinium myrtillus*.
- In dwarf-shrub heath, assessment of the proportion of shoots browsed initially requires close observation, and some practice, since shoots are small structures and, except at the very highest browsing intensities, browsing is always patchy over a range of spatial scales. Even with experience, assessment of browsing impact can be difficult in heaths

Guidance notes

where there is significant wind-clipping since this results in significant dieback of shoot tips irrespective of the amount of browsing which has occurred.

- In wind-clipped summit heaths careful, close scrutiny is required. Direct evidence of grazing on the vegetation can be difficult to observe because of the obscuring effects of wind-clipping and because the plants are small and low-growing. Also, rates of leaf removal by grazing animals tend to be low in comparison with habitats at lower elevations and may only occur during a very limited period of the year. For example, *Juncus trifidus* tends to be grazed only at the start of its period of growth (late May - June); observations later in the season are likely to reveal only missing tips to the leaves (since the leaves will have continued to grow) and perhaps missing flower-heads or fruit-heads.

Identification of shoot structures and annual growth in dwarf-shrubs and shrubs

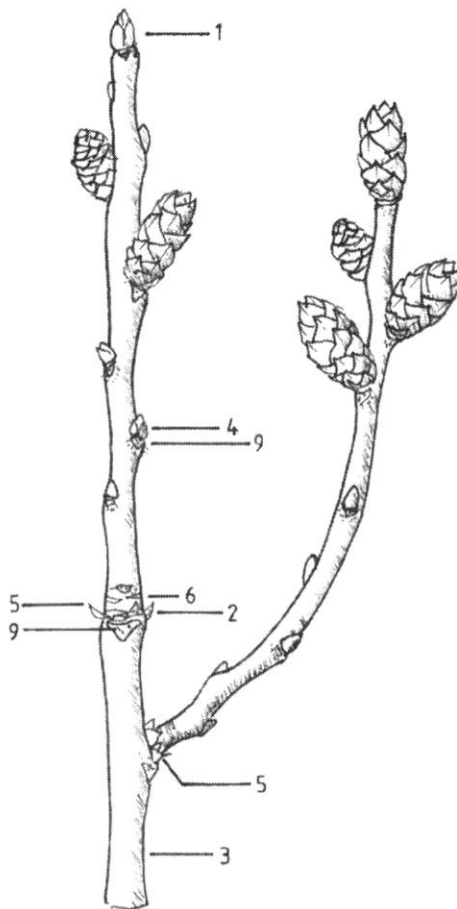
Key

Features as seen in late winter/early spring, before the start of shoot extension in the new growing season. (N.B. Drawings are not to scale.)

- | | |
|---|---|
| 1 End of previous season's growth | 7 "Joint" formed by bowl-shaped seat of bud/shoot |
| 2 Start of previous season's growth | 8 Closely spaced, smaller leaves |
| 3 Old shoot material (as in browsing into old material) | 9 Leaf scar |
| 4 Bud | 10 Long-shoot |
| 5 Bud scales | 11 Short-shoot |
| 6 Bud scale scars | |

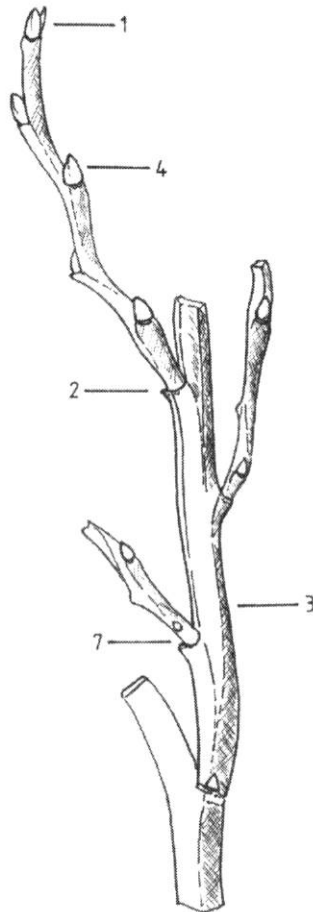
Identification of shoot structures and annual growth in dwarf-shrubs and shrubs

Myrica gale



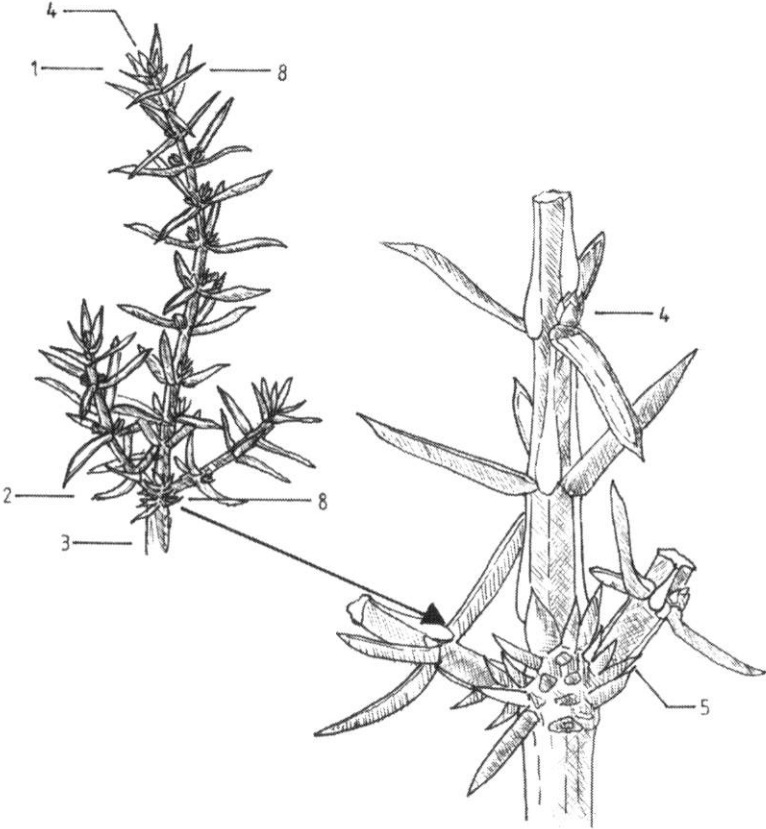
Identification of shoot structures and annual growth in dwarf-shrubs and shrubs

Vaccinium myrtillus



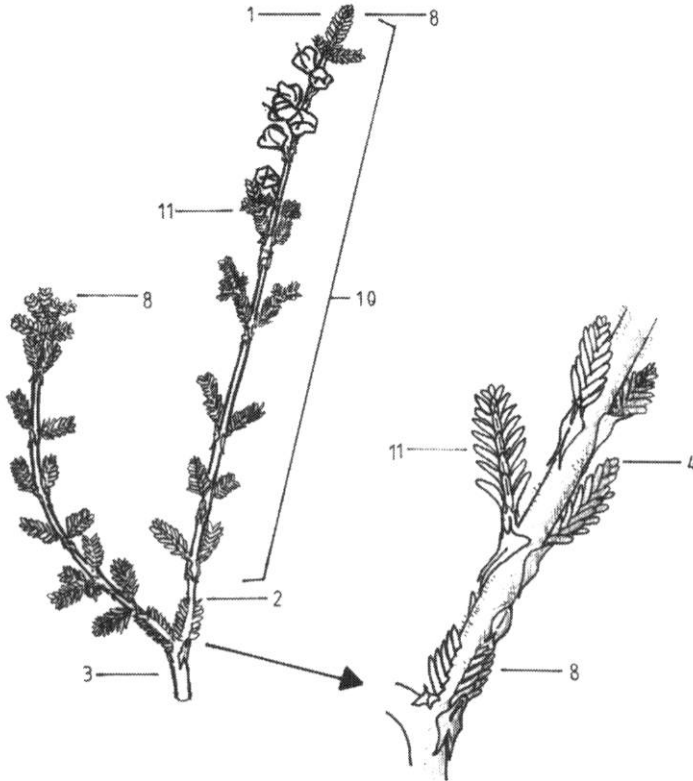
Identification of shoot structures and annual growth in dwarf-shrubs and shrubs

Juniperus communis



Identification of shoot structures and annual growth in dwarf-shrubs and shrubs

Calluna vulgaris



Part 2: Phase 1 Impact Survey

Large-scale Field Indicators

Smooth grassland

Grazing



Surface texture and colour of vegetation as seen with the naked eye from several hundred metres away.

- Very short, even, very smooth sward (“like a bowling green”). Distinctly green, possibly bright green (bluish green to yellowish green). ... **H**

NB. The underlying ground surface may be made up of stabilised boulders which make the ground uneven and hummocky.

- Short but somewhat uneven sward with some scattered tufts. Three dimensional structure of sward just perceptible. ... **M**

- Longer, patchily uneven sward, rough surfaced from well developed plant clumps and tufts. Readily apparent that there is a three dimensional structure to the sward. Pale straw coloured tinge to the sward in winter due to the accumulation of dead plant litter. ... **L**

NB. Grazing is always patchy. When grazing is very light there may be scattered patches which may seem to be classifiable as lightly or even moderately grazed within a matrix of ungrazed vegetation.



Sheep scars (Figs. 1 - 2).

- Frequent and conspicuous ($> 20 \text{ ha}^{-1}$ over areas of $> 1 \text{ ha}$). Mostly active and eroding. ... **H**

NB. Sheep scars are most likely to be formed on steep slopes over soils which are coarse-textured, free-draining, gritty or sandy. They may not always accompany heavy grazing.

- Scarce or absent, or if present then nearly all inactive and ground revegetating. ... **L**

Flush

Grazing and trampling



Amount of trampled bare peat, or mud, and sparseness of the vegetation.

NB. Take care to distinguish sparsely vegetated flushes with trampled mud or peat from the stoney flushes which are nearly always sparsely vegetated (use binoculars). A trampled stoney flush will tend to become muddy.

- Bare peat or mud across > 75 % of the width of the flush. Vegetation cover very sparse or apparently absent. ... **H**
- Bare peat or mud across 25 % - 75 % of the width of the flush. Vegetation cover clearly present, though patchy. ... **M**
- Bare peat or mud across < 25 % of the width of the flush. Vegetation cover more or less continuous, possibly with patchy breaks in the cover. ... **L**

Tall herbs

Grazing




Patches of tall herbs, with ferns or tussocky grass, easily visible with the naked eye at a hundred metres or more (or further if you use binoculars).

- Clumps of ferns or tussocky grass may be indicative but otherwise not distinguishable until within several metres. ... **H**
- Well developed patches of ferns or tussocky grass with some herb species obviously present. ... **M**
- Well developed patches of tall herbs, with ferns or tussocky grass, clearly visible (Fig. 3). ... **L**



Scrub


Browsing, grazing and trampling

-  Browse-line or close clipping of saplings and bushes to give “topiary” forms, particularly in small or open stands of scrub.
- NB.* In large and/or dense stands it may not be possible to determine without close investigation if effects extend far from the edge.
- Conspicuous and extensive (Fig. 4). ... **H**
 - Infrequent or absent, and/or weakly developed examples. ... **M**
... **L**

Blanket bog

Drying and peat loss (including disturbance from draining, peat cutting or erosion)

-  Spacing of slits, drains or trenches.
- < 20 m ... **H**
 - 20 m - 40 m ... **M**
 - > 40 m ... **L**
-  Depth of slits, drains, or trenches.
- > 1 m ... **H**
 - 0.5 m - 1 m ... **M**
 - < 0.5 m ... **L**

-  Presence of an irregular patterning of small hummocks (each up to several m² in size) producing a gently undulating surface.
- NB.* Take care to distinguish between hummocks, mostly composed of *Sphagnum* moss or its remains, and tussocks of graminoids. The latter are often more developed in drier bogs.

Blanket bog

Drying and peat loss

(including disturbance from draining, peat cutting or erosion)

- Not obviously hummocky. ... **H**
- Hummocky in parts. ... **M**
- Conspicuously and predominantly hummocky. ... **L**



Extent of bare peat.

- Bare peat showing through a thin vegetation cover over extensive areas ($>$ several 100 m^2), or completely bare peat in large and/or multiple patches (individual patch size $>$ 2 m^2) dispersed over the majority of the assessment unit. ... **H**
NB. In extreme cases most of the bog surface will have been stripped. This may be preparation for extensive peat extraction or it may be the result of a severe fire.
NB. Bare peat can be exposed extensively as a result of erosion which has developed naturally or subsequent to peat cutting, drainage or burning. This can be exacerbated by trampling by livestock or deer.
- Bare peat showing through a thin vegetation cover over limited areas ($<$ several 100 m^2), or completely bare peat in small, sparse patches (individual patch size $<$ 2 m^2). ... **M**
NB. Livestock may concentrate along spoil ridges from drains, their trampling hindering revegetation.
- Most of the assessment unit well vegetated with little bare peat exposed. ... **L**



Extent and vigour of *Calluna vulgaris*.

- Conspicuous and extensive over most of the assessment unit. Dark green, brownish or purplish-green patches and strips. ... **H**
NB. Patches of *Erica tetralix* will appear greyish green.
- Scattered patches, mostly on higher hummocks and baulks, thin strips edging drains. ... **M**

Blanket bog

Drying and peat loss (including disturbance from draining, peat cutting or erosion)

- Absent or very scattered. Any denser patches are non-linear. ... **L**

Blanket bog

Burning: intensity of impact

Geographical applicability of indicators

Racomitrium lanuginosum can be naturally abundant in areas of extremely oceanic, or montane, climate.



Extent of bare peat in the burnt patch (use binoculars).

- Bare peat showing through a thin cover of live or dead plant material over most of the burnt area, and/or completely bare peat in several patches (individual patch size $> 2 \text{ m}^2$). ... **H**
NB. In extreme cases the fire may burn through to the mineral substrate.
- Little or no bare peat. ... **M**

L



Pattern of fire advance.

- Uniform. No unburnt patches even in hollows. ... **H**
- Baulks and ridges uniformly burnt but hollows missed or lightly singed. ... **M**
- Very irregular with many patches remaining unburnt even on baulks and ridges. ... **L**



Colour of burnt patch immediately after burning.

Blanket bog

Burning: intensity of impact

- Uniformly very black, dark brown or ash-grey with an extensive covering of ash and fine charcoal, or the colour of exposed subsoil. ... **H**
NB. The mineral substrate may show through in places in extreme cases.
- Uniformly black speckled with charcoal (not exposed peat). ... **M**
- Very patchily black speckled with charcoal (not exposed peat). ... **L**



Pattern of revegetation after burning.

- Very patchy and irregular, may include some trees and shrubs, “grassy” patches, and patches of mosses and lichens, as well as dwarf-shrubs. ... **H**
NB. A very intense fire will often result in a very irregular and unstable surface which revegetates very slowly.
- More or less uniform. ... **M**
L



Occurrence of extensive (100's m²) dark brown, black, grey, greyish green, dark green or bright yellow-green crusts or carpets of lichens, algae, or mosses. Mosses likely to be *Racomitrium lanuginosum* or “bottle-brush” mosses (*Polytrichum* spp. or *Campylopus* spp.).

NB. Moss patches can sometimes appear greyish green (*Racomitrium lanuginosum* and certain *Campylopus* spp.). *Polytrichum commune* is usually dark green but old patches can appear rusty brown when dry in summer. May occur as rings around the edges of peat-filled basins (Fig. 5). May also colonise peat exposed by trampling.

- Conspicuous, widespread. ... **H**
NB. Likely to remain dominant for many years (> 10 yrs) after a very intense fire.

Blanket bog

Burning: intensity of impact

- Infrequent small, scattered patches (< 0.5 m across) or small tufts mixed with *Sphagnum*. ... **M**
NB. Most likely where the fire was somewhat hotter or where the litter/moss layer was thin. Take care to distinguish from mats of “feather” mosses.
- Absent or very scarce. ... **L**

Blanket bog

Burning: frequency of fires

Geographical applicability of indicators.

Racomitrium lanuginosum can be naturally abundant in areas of extremely oceanic, or montane, climate.



Extent of bare ground, or ground carpeted by *Racomitrium lanuginosum* or “bottle-brush” mosses (e.g. *Polytrichum* spp. or *Campylopus* spp.), crust-forming lichens or algal mats.

- Extensive. ... **H**
NB. Indicative of heavy frequent burning.
NB. Persistent but scattered patches of bare or eroded ground, lasting for many decades, may occur in heavily burnt patches, regardless of overall frequency of burning.
- Little or none. ... **M**
L



Dominance of dwarf-shrubs relative to graminoids.

- Appears “grassy”. ... **H**
NB. Dwarf-shrub plants may be inconspicuous in wet, undrained bogs during the first 5 yrs after burning, regardless of burning frequency, or after heavy winter browsing.

Blanket bog

Burning: frequency of fires

- Dwarf-shrubs conspicuous, occurring as sporadic patches and scattered stems. ... **M**
- Frequent and widely dispersed patches in which dwarf-shrubs appear dominant. ... **L**

Blanket bog

Trampling and grazing

Geographical applicability of indicators.

Eriophorum vaginatum tends to have low cover in bogs in the Western Isles and north-west mainland.



Bare peat exposed by trampling, wallowing and rubbing by livestock and deer.

NB. Bare peat can also result from erosion following heavy burning or intensive peat cutting.

- Frequent and conspicuous, perhaps actively eroding (Fig. 6). ... **H**

NB. Particularly along fence-lines and in peat cuttings, and beside or between natural features such as rock outcrops, lochans and erosion systems. Once severe erosion is initiated it *may* continue even if trampling is light.

- Localised and infrequent. Little or no active erosion. ... **M**
- Very scarce or absent, or if present then erosion inactive and ground revegetating. ... **L**



Extent of sheep, deer or cattle paths.

- Extensive and conspicuous, ramifying over most of the bog surface. ... **H**
- Conspicuous, but very localised, mostly restricted to dry

Blanket bog

Trampling and grazing

- ridges or fencelines. ... **M**
- Absent, or occasional single paths showing little branching. ... **L**



Amount of flowering of *Eriophorum* spp.

- Little or none. Inconspicuous. ... **H**
- Patchily abundant, or widespread but thinly scattered. ... **M**
- Widespread and abundant. Very conspicuous. (Fig. 7) ... **L**



Colour of *Calluna vulgaris* patches when dry and viewed from a distance.

- Greyish (Figs. 8 - 10). ... **H**

NB. Be careful to distinguish from grey-green patches in which *Erica tetralix* is dominant.

NB. Immediately after rain, heavily browsed areas tend have a very dark-grey or even black cast while relatively unbrowsed patches are reddish- or brownsh-green.

NB. Burnt patches can have a greyish appearance for a number of years after burning if much unburnt stem material remains.

- Dark purplish-brown to brownish-green. ... **M**
... **L**

NB. Abundant flowering will give *Calluna vulgaris* a mauve cast while an abundant crop of seed capsules (over winter) will give a pale fawn cast which may appear greyish in some lights.



Luxuriance of *Sphagnum*, dwarf-shrubs, and sedges on very small islands (< 1 - 2 m²) in permanent bog pools, < 2 m from the bank, relative to the surrounding bog surface.

- Island > surrounding bog. ... **H**
... **M**

NB. The island should be close enough to the bank to be likely to experience the same fire regime as the surrounding bog but should be too small to attract grazing animals.

Blanket bog

Trampling and grazing

- No difference. ... L

Wind-clipped summit heath

Grazing and trampling



Obvious evidence of grazing in associated flushes.

- Yes. Conspicuous and easily observed. ... H
L
- Little or none. ... L

Burning



Signs of burning.

- Any sign of burning at all. ... H

Dwarf-shrub heath

Browsing



Colour of *Calluna vulgaris* patches when dry and viewed from a distance.

- Greyish (Figs. 8 - 10). ... H

NB. Grey patches of dwarf-shrubs can occur in very exposed situations, most often at high altitudes (usually above 600 m) or near the coasts (see also **Damage by insects, fungi or weather**), even when browsing is light.

NB. When wet, heavily browsed areas tend have a very dark-grey or even black cast while relatively unbrowsed

Dwarf-shrub heath

Browsing

patches are reddish- or brownish-green.

NB. Burnt patches can have a greyish appearance for a number of years after burning if much unburnt stem material remains, and once the charcoal has begun to weather from the stems (becomes obvious 1 - 2 yrs after burning).

NB. *Deschampsia flexuosa* is often abundant for up to 5 yrs after fire and its flowering stems may give stands a pinkish fawn cast in summer and autumn, which may appear greyish or silvery in some lights.

- Dark purplish-brown to brownish-green. ... **M**
... **L**

NB. Abundant flowering will give *Calluna vulgaris* a mauve cast while an abundant crop of seed capsules (over winter) will give a pale fawn cast which may appear greyish in some lights.



Breadth of zone of obviously heavily browsed dwarf-shrubs at the interface with grassland, particularly **Smooth grassland**.

- Broad (> 10 m), continuous. ... **H**
- Narrow (1 m - < 10 m), may not be continuous (Figs. 11 - 12). ... **M**
- Very narrow or absent (< 1 m), discontinuous, patches of dwarf-shrubs uniform in colour and texture right up to a very sharp transition to grass. ... **L**



Sward height in associated grass patches (especially **Smooth grassland**).

- < 5 cm, with little accumulation of dead plant litter in the sward. ... **H**
... **M**
- > 5 cm, with obvious accumulation of dead plant litter in the sward. ... **L**



Sheep scars (Figs. 1 - 2).

Dwarf-shrub heath

Browsing

- Frequent and conspicuous ($> 20 \text{ ha}^{-1}$ over areas of $> 1 \text{ ha}$).
Mostly active and eroding. ... **H**
NB. Sheep scars are most likely to be formed where there are peat banks, or steep slopes over soils which are coarse-textured, free-draining, gritty or sandy (possibly also with a peaty surface layer). They do *not always* accompany heavy browsing.
- Very localised and not numerous where they do occur ($< 20 \text{ ha}^{-1}$ within in areas of $< 1 \text{ ha}$). Variably active. ... **M**
- Scarce or absent, or if present then nearly all inactive and ground revegetating. ... **L**



Browsing of seedlings or saplings of deciduous trees and shrubs (such as *Sorbus aucuparia*, *Betula* spp. and *Salix* spp.) present within the dwarf-shrub stand.

NB. Extrapolating further than 50 m from the location of the saplings or bushes may be unreliable.

- Heavily browsed. ... **H**
M
L
- Lightly to moderately browsed. ... **L**

Dwarf-shrub heath

Burning: intensity of impact



Amount of erosion initiated after burning.

NB. Occurs especially after periods of heavy rainfall. May take some time to occur.

- Some gullying and sheet erosion visible. ... **H**
NB. After a very intense fire bare mineral soil or subsoil will be exposed and erosion may be initiated. The surface

Dwarf-shrub heath

Burning: intensity of impact

may be very broken after fires which have burnt into peat.

- Little or no gullying or perceptible sheet erosion. ... **M**
- No perceptible erosion. ... **L**



Pattern of fire spread.

- Uniform. No unburnt patches within the outer boundaries of the burnt area. ... **H**
NB. Where the ground is very broken fire spread may appear to be patchy and irregular.
- Not uniform, but regular with few patches left unburnt. ... **M**
- Very irregular with many patches remaining unburnt within the boundaries of the burnt area (Fig. 13). (If *Juniperus communis* is present, bushes, or parts of bushes, may be missed by the flames and survive). ... **L**



Colour of burnt patch immediately after burning.

- Uniformly very black or ash-grey with extensive covering of ash and fine charcoal, or the colour of exposed subsoil. ... **H**
- Patchily grey and black, with small patches of ash scattered over the ground surface immediately after burning, though charcoal and heavily charred woody material ubiquitous and abundant. ... **M**
- Very patchily blackened, little ash even immediately after burning but much lightly charred woody material (Fig. 13). ... **L**



Pattern of revegetation after burning.

- Very patchy and irregular, may include some trees and shrubs, “grassy” patches, patches of mosses and lichens, as well as dwarf-shrubs. ... **H**
NB. A very intense fire will often result in either a very stony or very unstable surface which revegetates very slowly.

Dwarf-shrub heath

Burning: intensity of impact

- More or less uniform, mostly by dwarf-shrubs. ... **M**
- Uniform but structurally varied. ... **L**



Occurrence of extensive (100's m²) dark brown, black, grey, greyish green, dark green or bright yellow-green crusts or carpets of lichens, algae, or mosses. Mosses likely to be "bottle-brush" mosses (*Polytrichum* spp., *Campylopus* spp.).

NB. Moss patches can sometimes appear greyish green (certain *Campylopus* sp). Old patches of *Polytrichum commune* can appear rusty brown when dry in summer. Similar crusts and carpets can probably form on peat exposed by trampling.

- Widespread (Fig. 14). ... **H**
NB. Likely to remain dominant for many years (> 10 yrs) after a very intense fire but may be unstable, parts periodically breaking up then blowing or washing away.
- Present but not as extensive, dominant carpets. ... **M**
- Absent or occurring infrequently as small, scattered patches (< 0.5 m across). ... **L**

NB. Most likely where the fire was somewhat hotter or where the litter/moss layer was thin.

Dwarf-shrub heath

Burning: frequency of fires



Structural variation between patches of dwarf-shrubs burnt at different times.

NB. All patches may be short (< 15 cm) when heavily browsed, or in exposed locations, or at high altitudes.

- Relatively uniform. ... **H**
L

Dwarf-shrub heath

Burning: frequency of fires

- Mixture of patches, each relatively uniform, but collectively showing a wide variation in vegetation height (Fig. 15), often apparent as differences in texture. ... **M**



Height of dwarf-shrubs relative to graminoids.

NB. Dwarf-shrub plants will be short during the first 5 yrs after burning regardless of burning frequency.

NB. Heavy browsing may result in relatively short dwarf-shrub plants if graminoids are relatively unpalatable species (e.g. *Nardus stricta*).

- Much shorter. ... **H**
- Taller in the majority of patches. ... **M**
- Taller in nearly all patches. ... **L**



Extent of bare ground, or ground carpeted by “bottle-brush” mosses (e.g. *Polytrichum* spp. or *Campylopus* spp.), crust-forming lichens or algal mats.

- Extensive. ... **H**

NB. Indicative of very heavy frequent burning. May be exacerbated by livestock trampling.

- Little or none. ... **M**
... **L**

NB. Persistent but scattered patches of bare or eroded ground, lasting for many decades, may occur in heavily burnt patches, regardless of overall frequency of burning.

Tussock grassland

Grazing



Sheep scars (Fig. 1 - 2).

- Frequent and conspicuous ($> 20 \text{ ha}^{-1}$ over areas of $> 1 \text{ ha}$).
Mostly active and eroding. ... **H**
NB. Sheep scars are most likely to be formed where there are peat banks, or steep slopes over soils which are coarse-textured, free-draining, gritty or sandy (possibly also with a peaty surface layer). They may not always accompany heavy grazing.
- Very localised and not numerous where they do occur ($< 20 \text{ ha}^{-1}$ within areas of $< 1 \text{ ha}$). Variably active. ... **M**
- Scarce or absent, or if present then nearly all inactive and ground revegetating. ... **L**

Tussock grassland

Burning: intensity of impact



Amount of erosion initiated after burning.

- Any erosion present. ... **H**
NB. Exposure of bare soil, sufficient to be susceptible to erosion, is very unusual after a grass fire and indicates an unusually intense burning incident.
- No perceptible erosion. ... **M**
L



Pattern of fire advance.

- Uniform. No unburnt patches within the outer boundaries of the burnt area. ... **H**
- Not uniform but regular with few patches left unburnt. ... **M**

Tussock grassland

Burning: intensity of impact

- Very irregular with many patches remaining unburnt within the outer boundaries of the burnt area. ... **L**



Colour of burnt patch immediately after burning.

- Uniformly very black or ash-grey with extensive covering of ash and fine charcoal. ... **H**
- Patchily grey and black, with small patches of ash and fine charcoal scattered over the ground surface immediately after burning. ... **M**
- Very patchily speckled with fine black charcoal. ... **L**



Pattern of revegetation after burning.

NB. It is very helpful to know when the fire occurred if using this indicator.

- Patchy and somewhat irregular revegetation, with complete revegetation taking more than two growing seasons. ... **H**
- Almost complete, more or less uniform, revegetation in one to two growing seasons. ... **M**
L

Bracken

Vigour



Timing and rate of emergence and unfurling of fronds.

- Steady unfurling of fronds over May- late July. ... **H**
M
- Emergence and unfurling of > 50 % of fronds later than above. ... **L**

Bracken

Vigour



Timing of frond yellowing and dieback.

- Little of none before September. ... **H**
... **M**
- Substantial amount before September. ... **L**



Continuity and density of frond canopy (summer) or frond litter (winter).

- Continuously dense. ... **H**
- Dense in patches. ... **M**
- Not continuous or dense, scattered individual fronds or fronds in small groups. ... **L**

Part 3: Phase 2 Impact Survey

Small-scale Field Indicators and Trend Field Indicators

Smooth grassland

Grazing

Vole grazing.

Severe disruption of the sward can occasionally occur as a result of grazing by voles, and the making of runs, beneath the snow in winter. Dense networks of runs are usually centred on patches where moderate, but not large, amounts of snow accumulate and where grasses are more abundant, particularly tussocky grasses like *Deschampsia cespitosa* and *Nardus stricta*.

Slug grazing.

Heavy grazing of *Botrychium lunaria* is sometimes due to slugs rather than sheep. Slime trails and finely “nibbled” fronds are useful indicators. In high altitude grassland, patches of grazed flowers and leaf tips on *Silene acaulis* cushions usually are due to heavy slug grazing.

Geographical applicability of indicators.

Species mentioned may not all be present. *Alchemilla alpina*, *Armeria maritima*, *Minuartia sedoides*, and *Silene acaulis* are scarce or absent in the Southern Uplands. *Conopodium majus*, *Galium boreale*, *Saxifraga hypnoides* and *Trollius europaeus* are scarce or absent in the Western Isles and Northern Isles. *Helianthemum nummularium* is absent from, and *Lathyrus linifolius* is scarce in, western Scotland and the Northern Isles. *Cirsium heterophyllum*, *Galium boreale*, and *Trollius europaeus* are scarce or absent from the Western Isles and Northern Isles. *Geranium sylvaticum* is scarce or absent north of the Great Glen. Some indicators, although geographically widespread, may be altitudinally restricted e.g. *Silene acaulis*, *Minuartia sedoides*, *Huperzia selago*, *Saxifraga hypnoides*, *Sibbaldia procumbens* only occur in high altitude grasslands.

Small-scale Field Indicators



Sward height and texture.

- Very short, even, mostly < 3 cm, a few leaves > 6 cm. ... **H**
NB. Taller leaves are likely to be most noticeable in the latter half of the summer from July onwards.
NB. Heavy grazing by rabbits can reduce swards to < 1 cm tall.
NB. Heavy grazing by cattle is unlikely to produce swards < 3 cm tall.
- Somewhat patchy, mostly 3 cm - 6 cm, some parts may be taller, particularly if tussock-forming species are present. ... **M**
NB. Areas of short sward are likely to become larger in late summer to autumn as herbage accumulated during the peak of the growing season is consumed.
- Even or patchy, mostly 6 cm - 9 cm, < 25% of sward < 6 cm. ... **L**
NB. At low altitudes, on more fertile soils, sward height may be >> 9 cm.



Uprooted bundles of grass tillers.

- Abundantly scattered over the surface of the sward (Fig. 16). ... **H**
- Sparse or absent. ... **M**
... **L**



Accumulation of dead plant litter in the sward.

- Thin mat < 1 cm deep, or absent. No standing dead material in the sward. ... **H**
NB. There may be some standing dead material in tussocks of unpalatable species such as *Nardus stricta*, if these are present.
- Limited, forming a dense but thin mat (often mixed with mosses) 1 cm - 3 cm deep. Some standing dead material present in the sward. ... **M**
- Deep, though possibly loose, mat > 3 cm deep. Standing dead material very obvious in the sward. (Fig. 17) ... **L**

Phase 2 Impact Survey: Smooth grassland - grazing

Small-scale Field Indicators



Signs of grazing on *Alchemilla alpina*, *Juncus squarrosus*, *Nardus stricta*, *Prunella vulgaris*, *Sibbaldia procumbens*, or *Thymus polytrichus*.

- > 10 % of leaves cropped. Edges of *Nardus* tussocks disturbed, with some leaves grazed, and associated vegetation heavily grazed. ... **H**
- < 10 % of leaves grazed and then only around the margins of patches or where isolated leaves are scattered in the sward. *Nardus* tussocks largely undisturbed, though some of their leaves may be nibbled occasionally at the start of the growing season. ... **M**
- Very few or no leaves grazed. ... **L**



Signs of grazing (collectively) on legume species (e.g. *Lotus corniculatus*, *Lathyrus linifolius*, *Trifolium repens*) and/or *Plantago lanceolata*.

- Extensive to ubiquitous. Obvious without close inspection of plants. ... **H**
- Frequent and easily found, though possibly patchily distributed. ... **M**
- Limited, probably patchy, requiring searching or close inspection of plants, or absent. ... **L**



Signs of grazing on *Dryas octopetala* .

- Most shoots < 3 cm tall, ends of most stems and shoots bitten off with few or no flowers (Fig 18). ... **H**
- Some shoots > 3 cm tall, not all shoots bitten off, some flowers (flowers or seed heads < 2 per 100 cm²). (Fig. 18) ... **M**
- Many shoots > 3 cm tall with abundant flowers and seed heads (> 2 per 100 cm²). ... **L**



Flowering of grasses and forbs *other than* very small, creeping or cushion forming species, in which the flowers are carried at heights of < 3 cm, or less palatable species.

NB. Low growing plants to ignore include e.g. *Bellis perennis*, *Galium saxatile*, *Helianthemum nummularium*, *Minuartia sedoides*, *Polygalla serpyllifolia*, *Potentilla erecta*, *Saxifraga oppositifolia*, *Sibbaldia procumbens*,

Phase 2 Impact Survey: Smooth grassland - grazing

Small-scale Field Indicators

Silene acaulis, *Thymus polytrichus*, *Viola palustris*. Less palatable species include *Luzula campestris*, *Juncus squarrosus*, *Nardus stricta* and *Prunella vulgaris*.

- Sparse or none. ... **H**

NB. No flowering at all of grasses or herbs during the peak of the growing season indicates very heavy grazing.

NB. Some cushion-forming species, e.g. *Armeria maritima*, produce long-stalked flowers which are likely to be grazed.

NB. Sheep, but not cattle, show some avoidance of grass flowering stems.

- Scattered but noticeable flowering shoots, but majority of plants and tillers not flowering. ... **M**

- Moderately abundant to abundant flowering (collectively) of plants present (Fig. 19). ... **L**

NB. Even when the general grazing impact is low there may still be some removal of flowers from many herb species.



Signs of grazing on leaves of (collectively) *Agrostis capillaris*, *Anthoxanthum odoratum*, *Danthonia decumbens*, *Deschampsia flexuosa*, *Festuca rubra*, *Holcus* spp., *Poa* spp. and sedges.

- All, or nearly all, leaves grazed. Difficult to find ungrazed leaves. ... **H**

NB. During the peak of the growing season the signs of grazing may be less obvious, particularly for species with relatively fast leaf turnover (e.g. *Agrostis* spp.).

- Obviously but not completely grazed, on average > 50 % of leaves grazed. Ungrazed leaves can be found easily without intensive searching. ... **M**

- < 50 % of leaves grazed. Ungrazed leaves easy to find. ... **L**



Signs of grazing on leaves of (collectively) *Agrostis canina*, *Festuca ovina*, and *F. vivipara*.

- > 66 % of leaves grazed. General appearance will be that nearly all grass leaves are grazed. ... **H**

NB. During the peak of the growing season the signs of grazing may be less obvious. There may also be uprooted tillers of *Agrostis* and *Festuca* scattered over the surface.

Phase 2 Impact Survey: Smooth grassland - grazing

Small-scale Field Indicators

- Variable but obvious grazing, on average 33 % - 66 % of leaves grazed. ... **M**
- Not obvious, < 33 % of leaves grazed. ... **L**



Signs of grazing on leaves of *Deschampsia cespitosa*.

- > 15 % of leaves grazed. May be reduced to small (< 10 cm diameter), very tight, and obviously heavily grazed tussocks. ... **H**
- Variable, on average <15 % of leaves grazed. ... **M**
- Little or no obvious grazing. ... **L**



Cover of mosses, particularly “feather” mosses such as *Rhytidiadelphus squarrosus*, *Pleurozium schreberi*, *Pseudoscleropodium purum*, *Hypnum cupressiforme* and *Hylocomium splendens* (*Ctenidium molluscum* may be abundant in lime-rich situations).

- High cover, very obviously a major component of the sward, > 50 % of the total vegetation cover, giving the sward a golden-green colour (Fig. 20). ... **H**
- Present and relatively conspicuous, but constituting < 50 % of the total vegetation cover. ... **M**
- Present but not conspicuous or obvious except after close examination of the sward. ... **L**



Seedlings and saplings of trees and shrubs > 5 cm tall.

- Absent. ... **H**
M

NB. May be absent because there are no seed sources nearby (within several km) or because a tight sward is maintained in which no seedling regeneration niches occur.

- Present. ... **L**



Breakage and uprooting of shoots of *Silene acaulis*, *Minuartia sedoides*, *Huperzia selago*, *Saxifraga hypnoides*, or *Selaginella selaginoides*.

NB. These species tend to be incidentally uprooted during grazing and tend not to be eaten. *Saxifraga hypnoides*

Phase 2 Impact Survey: Smooth grassland - grazing

Small-scale Field Indicators

forms relatively loose cushions or mats with relatively brittle stems easily damaged by grazing animals.

- Conspicuous, > 20 % of the amount of whichever species affected. ... **H**
- Occasional, 10 % - 20 % of the amount of whichever species affected. ... **M**
- Very little, < 10 % of amount of whichever species affected. ... **L**



Density of shoots of cushion-forming plants, e.g. *Silene acaulis* and *Minuartia sedoides*, and occurrence of “weeding” of grasses from the cushions by grazing animals.

- Shoots compact, producing dense cushions; extensive “weeding” of cushions. ... **H**
M
- Shoots relatively straggly, producing loose cushions; no “weeding” of cushions. ... **L**



Amount of bare ground.

NB. Do not attribute bare ground caused by mole heaps, soil slippage, or rock falls to heavy grazing.

- Conspicuous, widespread. Surface disturbed by hoof marks. ... **H**
- None. ... **M**
L



Amount of dung of grazing animals (sheep and deer dung pellet groups).

NB. Dung can be relatively abundant in resting areas, and areas which provide shelter, without these areas necessarily being heavily grazed.

- Abundant, possibly conspicuous, > 30 dung pellet groups 100 m⁻² on average. If cattle, rabbit or hare dung then very frequent and widely dispersed over the sward. ... **H**
- Observable but only moderately abundant, about 10 - 30 dung pellet groups 100 m⁻². ... **M**
- Very little of none, < 10 dung pellet groups 100 m⁻². Cattle, rabbit or hare dung very scattered, requiring searching to find, or absent. ... **L**

Trend Field Indicators



Grazing impact indicated by sward height versus grazing impact deduced from signs of grazing on plants.

- By sward height < by signs of grazing on leaves and flowers. ... **I**
- By sward height > by signs of grazing on leaves and flowers. ... **D**

NB. Short swards can also result from harsh weather conditions and short growing seasons at high altitude or in very exposed locations.



Degree of flowering and vegetative state of potentially taller herbs such as *Achillea millefolium*, *Alchemilla* spp., *Cardamine* spp., *Conopodium majus*, *Galium verum*, *Ranunculus* spp., *Trifolium repens*, or tall herbs such as *Cirsium heterophyllum*, *Galium boreale*, *Geranium sylvaticum*, *Geum rivale*, *Rumex acetosa*, *Succisa pratensis* and *Trollius europaeus* (see also **Tall herbs**).

NB. Tall herbs may not be present. Even if they are present nearby and grazing is reduced to low intensities they are slow to invade unless suppressed plants are present in the sward.

- Plants dwarfed (leaves may be less than half normal size). ... **CH**
- Plants well developed and not obviously dwarfed. ... **CL**
- Plants not obviously dwarfed but both leaves and flowering shoots grazed. ... **I**
- Plants dwarfed but flowering, with little evidence of grazed leaves or flowering shoots. ... **D**



Cover and frequency of small, rosette-forming, creeping or mat-forming herbs (e.g. *Bellis perennis*, *Galium saxatile*, *Helianthemum nummularium*, *Minuartia sedoides*, *Polygalla serpyllifolia*, *Potentilla erecta*, *Saxifraga oppositifolia*, *Sibbaldia procumbens*, *Silene acaulis*, *Thymus polytrichus*, *Viola palustris*) or dwarfed plants of taller growing species.

- High cover and frequency, conspicuous or easily found. Total cover of grasses equal to, or less than, the total cover of other herbs in the sward. ... **CH**

NB. “Herb-rich” swards are usually moderately to heavily

Phase 2 Impact Survey: Smooth grassland - grazing

Trend Field Indicators

grazed but the reverse is not necessarily true. “Herb-rich” swards occur on relatively nutrient poor, but lime-rich, soils. On nutrient-rich soils a grass dominated sward can occur even under prolonged heavy grazing.

- Low cover and/or frequency, not easily found. Superficially the sward is very much dominated by grasses. ...CL

NB. Occasional tall herb plants may be conspicuous and these species can sometimes become patchily dominant.



Presence of “weedy” species such as *Cirsium arvense*, *Juncus effusus*, *Senecio jacobaea* or *Stellaria media* in dense, extensive patches (10's m² or more in size).

- Present. ...CH
D

NB. This indicates past heavy grazing which has led to soil disturbance by trampling (“poaching”) and nutrient enrichment. Current grazing may not necessarily be as heavy.







Presence of tree and shrub saplings.

NB. This applies to saplings and not seedlings. Saplings may be absent because there are no seed sources nearby (within several km) or because a tight sward is maintained in which no seedling regeneration niches occur.

- Present (small saplings may show signs of browsing) AND sward short. ... I

Agricultural improvement (liming, fertilising, reseeded)

Small-scale Field Indicators

	Presence of <i>Lolium perenne</i> .
<ul style="list-style-type: none"> • Present ... H • Absent ... L 	
	Presence of <i>Dactylis glomerata</i> .
	<i>NB.</i> May be naturally present in maritime grasslands.
<ul style="list-style-type: none"> • Present. ... H • Absent. ... L 	
	Frequency and cover of <i>Cerastium fontanum</i> , <i>Cynosurus cristatus</i> , and <i>Holcus lanatus</i> relative to the frequency and cover of <i>Festuca ovina</i> and <i>Potentilla erecta</i> .
	<i>NB.</i> May not apply in maritime grasslands.
<ul style="list-style-type: none"> • <i>Cerastium fontanum</i>, <i>Cynosurus cristatus</i> and <i>Holcus lanatus</i> each ubiquitous and contributing > 4 % ground cover AND <i>Festuca ovina</i> and <i>Potentilla erecta</i> both infrequent and of negligible cover. ... H 	
<ul style="list-style-type: none"> • <i>Cerastium fontanum</i>, <i>Cynosurus cristatus</i> and <i>Holcus lanatus</i> each infrequent or absent, with negligible cover if present, AND <i>Festuca ovina</i> and <i>Potentilla erecta</i> both abundant and frequent to ubiquitous. ... L 	
	Cover and frequency of <i>Trifolium repens</i> relative to frequency of <i>Potentilla erecta</i> .
<ul style="list-style-type: none"> • <i>Potentilla erecta</i> sparse or absent AND <i>Trifolium repens</i> > 33 % cover, frequent to ubiquitous. ... H 	
<ul style="list-style-type: none"> • <i>Potentilla erecta</i> ubiquitous, or nearly so AND variable cover and frequency of <i>Trifolium repens</i>. ... L 	

Flush

Grazing and trampling

Geographical applicability of indicators.

Species mentioned may not all be present. *Armeria maritima* occurs sometimes in higher altitude flushes above about 700 m (but sometimes as low as 300 m), usually is not abundant, and is absent from the Southern Uplands (except at the coast). *Crepis paludosa* and *Valeriana officinalis* are scarce or absent from the Northern Isles and Western Isles. *Myrica gale* is scarce in the eastern Southern Uplands and in the Northern Isles.

Small-scale Field Indicators



Percentage of surface churned and deeply pock-marked with hoof prints ("poached").

NB. In drier flushes, with relatively low water flows, heavy grazing of the vegetation may occur without substantial poaching. This is most likely when the main herbivores are small animals like sheep.

NB. Continuous high water flows produce stream channels. Intermittent high water flows, or a harsh montane climate, can be associated with much bare ground even in the absence of heavy grazing and trampling, indicated by the low frequency of hoof-marks. If scouring has been long-established it may not be possible to determine from field indicators if it was initiated by poaching.

- > 50 % of surface, hoof-prints clearly visible over virtually the entire flush. ... **H**
- *NB.* Occasionally, there may be wallows as well.
- < 50 % of surface, hoof-prints not clearly visible, or absent, from some parts the flush. ... **M**
- Relatively smooth surface (vegetated, or of silt or gravel) at a similar level to the surrounding vegetation, hoof prints very sparse, or absent. ... **L**

Phase 2 Impact Survey: Flush - grazing and trampling

Small-scale Field Indicators



Disruption of the moss and liverwort carpet around spring-heads and edges of rills.

- Completely disrupted, or absent. ... **H**
- Limited or patchy disruption (Fig. 21). ... **M**
- Virtually complete, little or no disturbance. ... **L**



Amount of pulled-up of mosses and other plants.

- Conspicuous and frequent over the surface of the flush. ... **H**
- Infrequent but still easily found without extensive searching. ... **M**
- Very little or none, if present then only found after extensive searching. ... **L**



Height of vegetation.

- < 5 cm tall. ... **H**
NB. Within about 2 m of spring-heads and rills, the vegetation is usually apparently short and dominated by mosses or liverworts (although the cushions and mats may be quite deep) even in the absence of grazing and trampling.
- 5 cm - 15 cm, but sometimes up to 50 cm. ... **M**
NB. Occasionally more, especially if shrubs like *Myrica gale* are present.
- > 15 cm tall on average, except at the edges of springs and rills or at altitudes above about 700 m (or above about 300 m in the far north and west). ... **L**



Percentage of leaves of sedges and grasses which collectively show signs of having been grazed.

- > 50 % ... **H**
- 25 % - 50 % ... **M**
- < 25 % ... **L**



Whether or not flowering heads of *Carex* spp. are extensively bitten-off.

- Extensively removed, hard to find any. ... **H**
- Partially removed, some grazed, some not grazed. ... **M**

Phase 2 Impact Survey: Flush - grazing and trampling

Small-scale Field Indicators

- Most not grazed; grazed flower heads hard to find. ... **L**



Signs of grazing on *Juncus effusus*, *Equisetum* spp., or *Erica tetralix*.

- Obvious, easily found. ... **H**

NB. Cattle and goats, the latter especially, can substantially graze *Juncus effusus* (and other less palatable species) even at moderate stocking rates, and in extreme cases the plants may be reduced to their fibrous leaf bases. Mountain hares sometimes also may graze *Juncus effusus*.

- Little or none, difficult to find. ... **M**

L



Amount of grazing of leaves and shoots, and amount of flowering, of *Cardamine pratensis* and *C. flexuosa*.

- > 50 % of leaves and shoots grazed, little or no flowering. ... **H**

- < 50 % of leaves and shoots grazed, some flowering. ... **M**

- Little or no grazing of leaves and shoots, most plants flowering. ... **L**



Vigour and degree of flowering of tall herbs *Crepis paludosa*, *Filipendula ulmaria*, *Succisa pratensis*, and *Valeriana officinalis*.

- All weak, small or dwarfed, non-flowering plants. ... **H**

- Some plants moderately vigorous and flowering. ... **M**

- Plants predominantly vigorous and flowering. ... **L**

NB. Where grazing is light or absent *Caltha palustris* and *Nartheicum ossifragum* plants also will be larger and will flower vigorously.



Flowering of *Armeria maritima*.

- Very few or no flowers, > 66 % of flower heads bitten-off. ... **H**

- Scattered to moderately abundant flower heads, 33 % - 66 % of flower heads bitten-off. ... **M**

- Plants carrying many flower heads, < 33 % of flower heads bitten-off. ... **L**

Phase 2 Impact Survey: Flush - grazing and trampling

Trend Field Indicators



Frequency or abundance of rushes or “grassland” species such as *Agrostis canina*, *Agrostis capillaris*, *Agrostis stolonifera*, *Anthoxanthum odoratum*, *Deschampsia cespitosa*, *Galium saxatile*, *Holcus lanatus*, *Juncus squarrosus*, *Molinia caerulea*, *Nardus stricta*, and *Potentilla erecta*; or of *Juncus effusus* or *J. acutiflorus*; or of *Polytrichum commune*.

- Very frequent or abundant, AND other indicators suggest current heavy grazing and trampling. ...**CH**
NB. *Molinia caerulea* at lower altitudes, and *Deschampsia cespitosa* at higher altitudes, may be abundant in the vegetation even if heavy grazing has not occurred in the past.
- Very frequent or abundant AND other indicators suggest light grazing and trampling. ... **D**
- Infrequent and sparse AND other indicators suggest heavy grazing and trampling. ... **I**



Height of any bushes of *Myrica gale* and *Salix* spp.

- > 1.5 m. ...**CL**

Tall herbs

Grazing

Fire.

This may produce effects similar to grazing but is likely to be unusual in this habitat. The presence of charred material in the litter and upper soil layers would be indicative of burning.

Geographical applicability of indicators.

Species mentioned may not all be present. *Cystopteris montana*, *Polystichum lonchitis*, and *Potentilla crantzii* are only found on lime-rich substrates. *Cirsium heterophyllum*, *Crepis paludosa*, *Galium boreale*, *Oreopteris limbosperma*, *P. lonchitis*, *Saussuria alpina*, *Trollius europaeus* and *Valeriana officinalis* are scarce or absent from the Western Isles and Northern Isles while *Athyrium distentifolium*, *P. lonchitis* and *S. alpina* are also scarce or absent from the Southern Uplands. *Oxyria digyna* is scarce in the Southern Uplands. *Geranium sylvaticum* is scarce or absent north of the Great Glen. *Osmunda regalis* is restricted to the western seaboard and islands. *C. montana* and *P. crantzii* have very restricted distributions. Montane willow species are of limited or rare occurrence, being most common on the more lime-rich rocks of the central Highlands.

Small-scale Field Indicators



Height of vegetation.

- Mostly < 20 cm. ... **H**
- Variable, but some > 20 cm (including flowering stems). ... **M**
- Mostly > 20 cm (except on unstable and broken ground where vegetation height may be very variable), some \geq 50 cm. ... **L**

Phase 2 Impact Survey: Tall herbs - grazing

Small-scale Field Indicators



Signs of grazing, vigour and flowering of commoner tall herbs such as *Alchemilla* spp., *Angelica sylvestris*, *Deschampsia cespitosa*, *Geranium sylvaticum*, *Geum rivale*, *Luzula sylvatica*, *Sedum rosea*, *Trollius europaeus*, and *Heracleum sphondylium*.

- All plants obviously heavily cropped, probably dwarfed if present, non-flowering. Only *Luzula sylvatica* likely to be at all abundant. (Figs. 22 - 23) ... **H**
- Some plants only partially cropped or ungrazed. Some of the above species abundant (in addition to *Luzula sylvatica*), easily recognisable and sparsely flowering. ... **M**
- Many plants only partially cropped or ungrazed. Some of these species both abundant and vigorously flowering (Figs. 24 - 25). Good growth and flowering of one or more of *Cirsium heterophyllum*, *Crepis paludosa*, *Filipendula ulmaria*, *Galium boreale*, *Oxyria digyna*, *Potentilla crantzii*, *Saussuria alpina*, *Solidago virgaurea*, *Succisa pratensis*, and *Valeriana officinalis*. ... **L**

NB. On acid soils, and sometimes on more lime-rich soils, a few very vigorous, large and competitive species, e.g. *Luzula sylvatica*, *Filipendula ulmaria*, *Oreopteris limbosperma*, *Dryopteris filix-mas*, *D. affinis*, and *D. dilatata*, may assume complete dominance in the absence of grazing.



Degree of browsing of any dwarf-shrubs present (see **Dwarf-shrub heath** for indicators.)

- Moderately to heavily browsed. ... **H**
- Lightly browsed. ... **M**
- Unbrowsed. ... **L**



Evidence of grazing of ferns.

- Some easily observable signs of grazing on *Oreopteris limbosperma*, *Athyrium filix-femina* and most *Dryopteris* spp. Heavy grazing of *Athyrium distentifolium*, *Polystichum lonchitis*, *Cystopteris montana*, *Osmunda regalis*, *Dryopteris expansa* if any of these are present. ... **H**

Phase 2 Impact Survey: Tall herbs - grazing

Small-scale Field Indicators

NB. Although ferns may be heavily grazed the more widespread species such as *Oreopteris limbosperma* generally will be grazed less than other herbs.

- *Oreopteris limbosperma*, *Athyrium filix-femina* and most *Dryopteris* spp. little grazed, and certainly much less grazed than tall herb species. Heavy grazing of *Athyrium distentifolium*, *Polystichum lonchitis*, *Cystopteris montana*, *Osmunda regalis*, *Dryopteris expansa* if any of these are present. ... **M**
- Ungrazed *Oreopteris limbosperma*, *Athyrium filix-femina*, and *Dryopteris* spp.. Little or no evidence of grazing on *Athyrium distentifolium*, *Polystichum lonchitis*, *Cystopteris montana*, *Osmunda regalis*, *Dryopteris expansa*. ... **L**

Trend Field Indicators



Conspicuousness and dominance of tall herbs relative to grassland species.

- Few tall herbs present except *Luzula sylvatica* (and even this may be sparse) AND grasses abundant or predominant in the vegetation. ... **CH**
- Tall herbs moderately abundant and diverse (though may still be dwarfed by grazing), *Luzula sylvatica* possibly abundant AND grassland species conspicuous but sub-dominant in the vegetation. .. **CM**
- Heavily suppressed tall herbs and ferns AND grassland species inconspicuous. ... **I**



Seedlings and small saplings of *Sorbus aucuparia*, *Betula pubescens*, *Populus tremula*, *Fraxinus excelsior* and *Juniperus communis*.

- Present. ... **CL**



Flowering of tall herbs relative to their form and vegetative vigour.

- Abundant flowering but small and stunted plants. ... **D**

NB. May indicate recent light grazing (within the last five years) after a period of heavier grazing. (N.B. Check that

Phase 2 Impact Survey: Tall herbs - grazing

Trend Field Indicators

stunting is not due to harsh climate by inspecting nearby dwarf-shrubs - see ***Dwarf-shrub heath*** for indicators).

Scrub

Browsing, grazing and trampling

Geographical applicability of indicators.

Species mentioned may not all be present. *Geranium sylvaticum* is scarce or absent north of the Great Glen. Montane willow species are of limited or rare occurrence, being most common and diverse on the more lime-rich rocks of the central Highlands. *Hedera helix*, *Hyacinthoides non-scriptus*, *Ilex aquifolium*, *Oxalis acetosella*, and *Rubus fruticosus* are scarce in the Northern Isles and Western Isles.

Small-scale Field Indicators



Evidence of browsing of trees and shrubs.

- Distinct browse-line and/or severe clipping of anything within reach of herbivores to produce “topiary”-like effects. Most shoots within reach of herbivores bitten, much of current year’s shoot growth removed and some shoots may be bitten beyond current year’s growth. (Fig. 26) ... **H**
- Diffuse or patchy browse-line which may not be immediately obvious, and no very clear effects on plant form, but browsed shoots still easy to find. Although twigs obviously browsed only tips bitten and some twigs remain unbrowsed. ... **M**
- No obvious browse-line. Browsed shoots difficult to find even on *Salix* spp., *Sorbus aucuparia* and *Ilex aquifolium*. ... **L**



Evidence of bark-stripping.

NB. When there is deep and persistent snow cover trunks and fallen branches may be extensively bark-stripped even when grazing/browsing pressure is not generally high.

- Present ... **H**
- Absent (or old) ... **M**
L

Phase 2 Impact Survey: Scrub - browsing, grazing, trampling

Small-scale Field Indicators



Presence and condition of seedlings and saplings of trees and shrubs.

- Saplings not projecting above field layer, many heavily browsed, making little or no height growth. ... H
- Saplings projecting above field layer locally, many showing some signs of browsing, scattered saplings able to make some height growth. Most pronounced browsing on *Sorbus aucuparia*, *Salix* spp. and/or *Ilex aquifolium*. ... M
- Saplings projecting above field layer, signs of browsing very slight (or absent) and/or very localised, many saplings making clear height growth (unless suppressed by shading). Little or no signs of grazing even on *Sorbus aucuparia*, *Salix* spp. or *Ilex aquifolium*. ... L



Disturbance to field layer and ground layer by grazing and trampling.

NB. Assessment should include disturbance to litter covered, as well as vegetated, surfaces.

- Patches of bare ground frequent and extensive. ... H
- Patches of bare ground few and small, or absent. ... M
L



Height of, and signs of grazing on, field layer herbs.

- < 10 cm AND conspicuous, extensive grazing of shoots and leaves. ... H
NB. If < 3 cm indicates very heavy grazing/browsing.
- 10 - 30 cm AND patchy or somewhat obscure signs of grazing of shoots and leaves. ... M
NB. Localised “greens” may still be close-cropped.
- > 30 cm AND signs of grazing on shoots and leaves are sparse and difficult to find. ... L



Degree of browsing of any dwarf-shrubs present (see **Dwarf-shrub heath** for indicators).

- Moderately to heavily browsed. ... H
- Lightly browsed. ... M
- Unbrowsed. ... L

Phase 2 Impact Survey: Scrub - browsing, grazing, trampling

Small-scale Field Indicators



Degree of grazing of tall herbs present (see **Tall herb** for indicators).

- Heavily grazed. ... **H**
- Moderately grazed. ... **M**
- Lightly grazed or ungrazed. ... **L**



Herbivore dung and tracks.

- Abundant, or at least obvious without extensive searching. ... **H**
- Sparse and not immediately obvious, may be difficult to find, or absent. ... **M**
L

Trend Field Indicators



Form and extent of shrub layer.

- Patchy and/or plants densely branched, possibly contorted. ... **CH**
- Patchy and/or plants densely branched, possibly contorted AND other indicators suggest light grazing/browsing ... **D**
- Widespread and/or little or no evidence of dense, contorted branching. ... **CL**
- Widespread and/or little or no evidence of dense, contorted branching AND other indicators suggest moderate or heavy grazing/browsing. ... **I**



Extent of field layer.

NB. The field layer may be poorly developed or absent for reasons other than grazing and browsing *e.g.* shading due to high densities of shrubs. The field layer responds to changes in herbivore use faster than the shrub layer.

- Sparse. ... **CH**
- Sparse AND other indicators suggest moderate or light grazing/browsing ... **D**
- Widespread but mostly thin or short. ... **CM**
- Widespread but mostly thin or short AND other indicators suggest heavy grazing/browsing. ... **I**

Phase 2 Impact Survey: Scrub - browsing, grazing, trampling

Trend Field Indicators

- Widespread but mostly thin or short AND other indicators suggest light grazing/browsing. ... D
- Widespread and well developed, dense and tall. ...CL
- Widespread and well developed, dense but short AND other indicators suggest moderate or heavy grazing/browsing. ... I



Composition of herbs in field layer.

NB. On acid soils dwarf-shrubs may be dominant or co-dominant in the field layer: see **Dwarf-shrub heath** for indicators.

- Grasses and/or mosses predominant. Surviving herbs usually dominated by unpalatable species such as *Oxalis acetosella* and *Hyacinthoides non-scripta*. More palatable, more grazing-sensitive species such as *Geranium sylvaticum*, *Hedera helix*, *Lonicera periclymenum*, *Luzula sylvatica*, and *Rubus fruticosus* confined to inaccessible areas (cliff ledges, islands) or noticeably more vigorous and abundant there. ...CH
- As above AND other indicators suggest moderate or light grazing. ... D
- Forbs and/or dwarf-shrubs dominant or co-dominant but mosses, although less obvious, may still be abundant in the ground layer. ..CM

NB. In heavily shaded situations mosses are often dominant or co-dominant.

- Forbs and/or dwarf-shrubs dominant or co-dominant AND other indicators suggest heavy grazing. ... I
- Forbs and/or dwarf-shrubs dominant or co-dominant AND other indicators suggest light grazing. ... D
- Grazing sensitive species such as *Hedera helix*, *Lonicera periclymenum*, *Luzula sylvatica*, and *Rubus fruticosus* collectively widespread, possibly abundant, and not restricted to situations inaccessible to larger herbivores. One or more of these is likely to dominate the field layer. *Pteridium aquilinum* may be abundant. ...CL
- As above AND other indicators suggest moderate or heavy grazing. ... I

Phase 2 Impact Survey: Scrub

Burning: intensity of impact

Small-scale Field Indicators



Effects of fire on any shrubs and trees.

- Very high mortality. Stems showing extensive deep charring and canopies extensively scorched or burnt. ... **H**
NB. Betula and Pinus seedlings may establish abundantly after fire wherever soil bared near to seed bearing trees.
- Occasional bushes and trees surviving. All *Juniperus* killed. ... **M**
- Bushes and trees mostly surviving, including some *Juniperus*; stems only partially damaged or superficially charred, canopies unaffected or slightly and patchily scorched. Small saplings may be damaged but likely to show vigorous resprouting from stem bases. ... **L**



Effects on field layer and ground layer dwarf-shrubs, tussock grasses and tall herbs in field layer.

NB. See burning sections of Dwarf-shrub heath and Tussock grassland.

- High intensity. ... **H**
- Moderate intensity. ... **M**
- Low intensity. ... **L**

Burning: frequency of fires

Small-scale Field Indicators



Abundance and form of shrubs and trees.

NB. Infrequent or small saplings and bushes may be due to heavy browsing. If long continued this will result in a lack of mature trees and bushes.

NB. If no nearby (< 1 km) parent shrubs and trees then effects may only indicate past elimination rather than present conditions.

- Very scarce, or absent. If present then only as small saplings < 2 m tall or bushes < 1 m tall. Bushes of *Juniperus communis* usually absent, even when there are nearby seed sources, but small and sparsely scattered bushes may be present.

... H

NB. The maximum height of most montane willows is < 1 m even in the absence of fire or browsing.

- Scarce, large shrubs and trees, but perhaps conspicuous, moderately abundant saplings and small bushes, bushes 1 - 2 m tall and some saplings 2 - 4 m tall. At patch scale *Juniperus communis* may be present as small to medium bushes if there are nearby seed sources, while at the landscape scale it is likely to occur as either scattered individuals or small patches.

... M

- Abundant and well developed bushes and stunted trees, at least some bushes > 2 m tall and some saplings > 4 m tall. At patch scale *Juniperus communis* may be present as small to large bushes, if seed sources are nearby, while at the landscape scale it may occur in extensive patches.

... L

NB. If saplings are browsed they may be short and may not obviously protrude above the dwarf-shrub canopy.



Effects on dwarf-shrubs in field layer.

NB. See burning section of **Dwarf-shrub heath**.

- High or moderate frequency.
- Low frequency.

... H

... M

L

Phase 2 Impact Survey: Scrub - burning frequency

Small-scale Field Indicators



Effects on tussock grass in field layer.

NB. See burning section of **Tussock grassland**.

- High or moderate frequency. ... **H**
- Low frequency ... **H**
M
L

Blanket bog

Drying and peat loss (including disturbance from draining, peat cutting or erosion)

Geographical applicability of indicators

Species mentioned may not all be present or equally applicable in different geographical areas. Both *Sphagnum fuscum* and *S. imbricatum* are relatively infrequent where they do occur and *S. fuscum* is scarce or absent in the Western Isles and Northern Isles. *Sphagnum* mosses generally may be sparse in high altitude and eastern bogs. *Eriophorum vaginatum* tends to have low cover in bogs in the Western Isles and north-west mainland. Dwarf-shrubs usually do not become dominant in the Western Isles. *Cladonia* lichens can be abundant in coastal situations and in areas with a more boreal climate, particularly north-east Scotland, in the absence of artificial drainage. *Racomitrium lanuginosum* can be naturally abundant in areas of extremely oceanic, or montane, climate.

Small-scale Field Indicators



Cracking of the peat in the walls of drains.

- Easily found, cracks > 0.5 cm wide, extending several metres or more from the drain edge. ... **H**

NB. Although cracks may refill with plant litter and loose peat they do not fully reseal. If this happens they may still be discernible, on close inspection, as changes in peat texture or patterns of water seepage.

- Not as above. ... **M**
L



Amount of water, water flow and scouring in drainage tracks.

NB. The amount of water should be assessed relative to the depth of the drain. For standard depths of drains see **Field indicators for types of peat cutting and drainage**.

Phase 2 Impact Survey: Blanket bog - drying and peat loss

Small-scale Field Indicators

- Water shallow or absent, but when present flows freely. Scouring widespread. ... **H**
NB. Drains may be fully charged with water in winter, especially after heavy rain. Scouring may not always be present.
- Variable depths and sluggish flow in at least some parts. Very limited or no scouring. ... **M**
- Deep and very sluggish in most ditches. No obvious scouring. ... **L**
NB. There may be a deep layer of saturated vegetation rather than open water. Infilled drains may be more clearly visible from a distance.



Amount and composition of vegetation in ditches and hollows.

- Exposed mineral soil, bare peat, or sparsely vegetated *e.g.* with thin *Eriophorum angustifolium*. ... **H**
- Abundant but mostly monospecific vegetation, often of rhizomatous, colonising species such as *Eriophorum angustifolium*. ... **H**
M
- Abundant *Eriophorum angustifolium* and/or abundant *Sphagnum* moss cover, including *S. cuspidatum*, *S. recurvum*, or *S. papillosum* (Fig. 27). There may also be present one or more of *Narthecium ossifragum*, *Drosera* spp., *Juncus* spp., *Myrica gale*, *Molinia caerulea*, and *Rhynchospora alba*. ... **H**
M
L



Abundance and diversity of *Sphagnum* mosses over the assessment unit.

- Complete, or almost complete, absence of *Sphagnum* mosses, even in hollows. ... **H**
NB. There may be a little *S. cuspidatum* or *S. recurvum* in hollows. Also, *Sphagnum* mosses may be much reduced due to frequent burning or heavy trampling by livestock.
- Occasional cushions of *S. capillifolium* (occasionally also *S. fuscum* or *S. imbricatum*), found with searching, on higher parts. ... **M**

Phase 2 Impact Survey: Blanket bog - drying and peat loss

Small-scale Field Indicators

- *Sphagnum* mosses forming the majority of the vegetation in hollows, with one or more species including *S. cuspidatum*, *S. recurvum*, or *S. papillosum*. ... M
- *Sphagnum* mosses abundant and varied (> 3 spp.) everywhere, even < 1 m from drain edges. ... L



Softness and wetness of the bog surface underfoot, over the whole assessment unit.

- Relatively firm, feet do not sink or sink very little into the surface, over most of the area. Little or no water extrudes under foot pressure. ... H
NB. Surface may be wet after prolonged or heavy rainfall.
NB. Frequent burning or trampling by livestock may also produce firm conditions underfoot.
- Ground mostly firm to soft underfoot, but not as above or below. ... M
- Soft to very soft, spongy, over most of the bog surface. Water extrudes under foot pressure. ... L
NB. During drought periods surface may be dry.



Extent and vigour of *Calluna vulgaris* relative to *Erica tetralix*.

- *NB.* *Erica tetralix* may be dominant to *Calluna vulgaris* in heavily browsed areas and in the first few years after fire.
- *Calluna vulgaris* dominant and vigorous over most of the assessment unit. *Erica tetralix* sparse and subdominant to *Calluna vulgaris*. ... H
NB. *Calluna vulgaris* may be stunted in the wetter hollows.
- *Calluna vulgaris* patchily distributed, largely restricted to higher baulks, < 2 m from drain edges, and hummocks. *Erica tetralix* widely distributed. ... M
- *Calluna vulgaris* absent or present as scattered, stunted plants. *Erica tetralix* the most widespread dwarf-shrub, codominant or subdominant in the vegetation, more dominant than *Calluna*. ... L
NB. *Calluna vulgaris* is very rarely completely absent.
NB. Although *Erica tetralix* may be the most abundant dwarf-shrub it may be stunted.

Phase 2 Impact Survey: Blanket bog - drying and peat loss

Small-scale Field Indicators



Presence of some or all of the following: *Juncus* spp., *Carex panicea*, *Nardus stricta*, *Deschampsia flexuosa*, *Agrostis* spp., *Polytrichum commune*, “feather” mosses, *Racomitrium lanuginosum* or bushy *Cladonia* lichens.

NB. May be particularly obvious along the spoil ridges of drains. In particular geographical areas *Racomitrium lanuginosum* (in the west) and *Cladonia* lichens (in the north-east Highlands) may not be reliable indicators.

- Widespread and abundant over the assessment unit. Not just restricted to driest hummocks or spoil ridges. Easily found.

... H

NB. *Juncus squarrosus* and *Nardus stricta* occur especially where the peat is thin (< 30 cm).

NB. Large persistent patches of *Polytrichum commune* can become widely established after very heavy burning.

- Scattered to widespread but not abundant. Mostly on driest hummocks and spoil ridges. Only found after extensive searching elsewhere.

... M

NB. May be abundant along the edges of drains.

- Absent to very sporadic over the assessment unit. Most likely to be found along spoil ridges beside drains (or where there is a transition to mineral soils).

... L

Trend Field Indicators



Characteristics of drains.

- Bare, scouring and becoming deeper.

... I

NB. See normal standard sizes of drains in **Field indicators for types of peat cutting and drainage.**

- Marked slumping of the ground around drains, extending several metres or more from the drain edges.
- Revegetating, infilling, becoming shallower.

... CH

... D

Phase 2 Impact Survey: Blanket bog - drying and peat loss

Trend Field Indicators



Location of greatest abundance of *Sphagnum*.

- Bog surface. ... **I**
NB. This indicates recently established drainage.
- In drains, provided these are totally blocked and *Sphagnum* is abundant and vigorous; or equally abundant in both drains and on bog surface. ... **D**



Extent of *Sphagnum* relative to its vigour.

- Widespread AND bleached, with hummocks and carpets possibly disintegrating. ... **I**
NB. Recent burning can also produce this effect. Droughts may also produce similar, but transient, effects.
- Sparse AND hummocks and carpets growing vigorously. ... **D**



Size of *Calluna vulgaris* plants relative to their vigour.

- Plants small and stunted AND shoot growth becoming more vigorous. ... **I**
- Plants > 25 cm tall AND weak growth of new shoots (< 4 cm yearly extension) with, possibly, partial dieback of branches on individual stems. ... **D**



Dominance of *Calluna vulgaris* relative to *Sphagnum* mosses.

- Overtopping and shading *Sphagnum* mosses. ... **I**
- Stems becoming overgrown by *Sphagnum* mosses, stems stunted or dying back, casting only light shade on *Sphagnum*. ... **D**



Dominance of *Juncus squarrosus* (and other herbs) relative to *Sphagnum* mosses.

- Overtopping and shading *Sphagnum* mosses. ... **I**
- Becoming overgrown by *Sphagnum* mosses. ... **D**

Burning: intensity of impact

Geographical applicability of indicators

Racomitrium lanuginosum can be naturally abundant in areas of extremely oceanic, or montane, climate. *Sphagnum fuscum* is scarce or absent in the Western Isles and Northern Isles.

Small-scale Field Indicators



Degree of combustion or “cooking” of the surface and upper layers of the peat.

- All or part of the surface layers of peat consumed. Uneven or bumpy surface. Surface lumps of unconsumed peat are likely to be solid and to have a rubbery texture, or brittle, bituminous crust which may be water-repellent. ... **H**
- Only surface scorching and only in small scattered patches (generally < 1 m² in size), mostly where peat was thinner or drier (e.g. where bedrock or boulders are near the surface). ... **M**
NB. May be occasional, very small patches of bare peat with a rubbery texture or brittle, bituminous crust.
- No burning or scorching of the peat surface. ... **L**



Damage to dense moss mats and hummocks by combustion or bleaching.

- > 50 % with > 1 cm removed from > 50 % of hummock or mat surface. ... **H**
- Most hummocks show only superficial damage: < 1 cm consumed over < 50 % of each hummock for > 50 % of hummocks. The surface of most cushions of *Sphagnum* (and *Leucobryum glaucum*), of all sizes, conspicuously bleached; difficult to find live tissue within 10 mm of the cushion surface, especially in cushions < 1 m wide. (Fig. 28) ... **M**
NB. Tall or loose hummocks are more likely to be damaged. Compact and dense hummocks are more likely to survive relatively undamaged.
- Mainly intact with sporadic charring or burning away of the

Phase 2 Impact Survey: Blanket bog - burning intensity

Small-scale Field Indicators

surface (< 1 cm removed). Cushions of *Sphagnum* (and *Leucobryum glaucum*) > 1 m wide, unbleached except around their edges. The surface of cushions < 1 m wide may be conspicuously bleached but easy to find live tissue within 10 mm of the cushion surface. ... **L**



Degree of combustion of loose moss mats, lichens and plant litter.

- Extensive, complete combustion or severe charring over > 25 % of the area. Burnt even in hollows. ... **H**
- Patchy consumption over < 25 % of the area, mostly as small scattered patches (generally < 1 m² in size). Unburnt or only very superficially charred in hollows. ... **M**
- Little or no scorching of plant litter or mosses. ... **L**



Degree of combustion of above-ground woody material.

- Combustion of a substantial proportion of woody stem material thicker than fine twigs. ... **H**
- Fine twigs of dwarf-shrubs consumed but most of the thicker stem material only surface charred. ... **M**
- Only the finest shoots consumed. Many dwarf-shrub stems merely scorched or missed entirely by fire. ... **L**

Burning: frequency of fires

Geographical applicability of indicators.

Species mentioned may not all be present or equally applicable in different geographical areas. *Sphagnum* mosses generally may be sparse in high altitude and eastern bogs. *Eriophorum vaginatum* tends to have low cover in bogs in the Western Isles and north-west mainland. *Rubus chamaemorus* is scarce or absent from the western seaboard, western islands and Northern Isles. Dwarf-shrubs usually do not become dominant in the Western Isles. *Vaccinium uliginosum* is scarce or absent in the Southern Uplands and Western Isles. *Cladonia* lichens can be abundant in coastal situations and in areas with a more boreal climate, particularly north-east Scotland, in the absence of burning. *Racomitrium lanuginosum* can be naturally abundant in areas of extremely oceanic, or montane, climate.

Small-scale Field Indicators



Solidity and texture of the upper peat layers.

- Solid under foot pressure even when waterlogged, possibly somewhat “rubbery” textured or water-repellent. ... **H**
NB. Particularly when heavily burnt. May lead to puddling of water on bare surfaces after rain.
NB. Drainage and livestock trampling can also create firm conditions underfoot.
- Spongy, not noticeably “rubbery” textured or water-repellent. ... **M**
L



Extent, diversity and luxuriance *Sphagnum* mosses.

- Sparse, thin mats (< 5 cm deep) of only 1 - 2 spp. (*S. tenellum* and/or *S. compactum* likely to be the most frequent species). ... **H**
- Extensive, sometimes cushions or hummocks 10 cm - 20 cm deep, > 2 spp. present. ... **M**
- Extensive and abundant, conspicuous mats and cushions 10 cm - 30 cm deep, > 2 spp. ... **L**

Phase 2 Impact Survey: Blanket bog - burning frequency

Small-scale Field Indicators



Extent and luxuriance of *Racomitrium lanuginosum* and “feather” mosses (e.g. *Hylocomium splendens*, *Pleurozium schreberi*).

NB. *Racomitrium lanuginosum* may not be a good indicator in the extreme west, while “feather” mosses may be quite abundant in naturally drier types of *Calluna - Eriophorum vaginatum* bog found at higher altitudes (above about 500 m in the west but occurring at much lower altitudes in the east).

- Extensive, conspicuously thick mats > 5 cm deep, or major component of hummocks. Easily found. ... **H**
- Patchily present, locally abundant but minor component on drier hummocks, may form thin mats < 5 cm deep or occur as scattered fronds through *Sphagnum*. Easily found with a little searching. ... **M**
- Scarce or absent. Only found after extensive searching. ... **L**



Relative structural dominance of dwarf-shrubs versus *Eriophorum vaginatum*, *Molinia caerulea*, and/or *Trichophorum cespitosum*.

- Dwarf-shrubs shorter and uniformly subdominant. ... **H**
- Dwarf-shrubs mostly of equal height and dominance to grasses and sedges. ... **M**
- Dwarf-shrubs mostly taller and dominant to grasses and sedges. ... **L**

NB. Dwarf-shrub plants may be inconspicuous in wet, undrained bogs during the first 5 years after burning, regardless of burning frequency, or after heavy winter browsing.



Abundance of some of the following: *Agrostis capillaris*, *Deschampsia flexuosa*, *Festuca ovina*, *Galium saxatile*, *Nardus stricta*, *Polygala serpyllifolia*, *Rubus chamaemorus*, and *Succisa pratensis*.

- Extensive, may be abundant. Easy to find. ... **H**
- NB.* Heavy grazing may reduce the abundance of *Rubus chamaemorus*.
- Patchily present in small amounts. Only found after some searching. ... **M**

Phase 2 Impact Survey: Blanket bog - burning frequency

Small-scale Field Indicators

- Sparse or absent. Difficult to find even with extensive searching. ... **L**



Abundance and luxuriance of “bushy” *Cladonia* lichens.

NB. Best developed in the north-east Highlands.

- Scarce or absent. ... **H**
- Frequent but not very abundant. ... **M**
- Abundant, particularly in more open patches (Fig. 29). ... **L**

Trend Field Indicators



Abundance and dominance of graminoids.

- Very abundant and dominant in terms of both cover and height. ... **CH**

NB. May also occur if dwarf-shrub regeneration fails *e.g.* for climatic reasons, or because of heavy browsing.

Trampling and grazing

Geographical applicability of indicators.

Species mentioned may not all be present or equally applicable in different geographical areas. *Eriophorum vaginatum* tends to have low cover in bogs in the Western Isles and north-west mainland. *Rubus chamaemorus* is scarce or absent from the western seaboard, western islands and Northern Isles. Dwarf-shrubs usually do not become dominant in the Western Isles. *Betula nana* is confined to a north-south zone running through the central mainland from the Central Highlands to northern Scotland. *Arctostaphylos uva-ursi* is scarce in the Southern Uplands and Northern Isles.

Small-scale Field Indicators



Trampling and grazing of pool systems and water tracks.

- Edges of pools broken down, neither abrupt vertical sides nor sloping *Sphagnum* covered edges. Wet hollows obviously trampled, hoof prints abundant, *Sphagnum* cover much disturbed or absent. ... **H**
- No evidence of trampling or grazing around pools, particularly those containing *Menyanthes trifoliata*, and water tracks. Wet hollows with intact *Sphagnum cuspidatum* cover. ... **L**







Trampling of *Sphagnum* moss hummocks and lawns.

- Most *Sphagnum* moss surfaces broken by hoof prints over most of the bog surface. Loose and bleached portions of *Sphagnum* mosses frequent. ... **H**
- Minority of *Sphagnum* moss surfaces broken by hoof prints, locally distributed over the bog surface. Loose and bleached portions of *Sphagnum* mosses very local. ... **M**
- Most *Sphagnum* moss surfaces intact. Evidence of hoof prints only found after extensive searching. Loose and bleached portions of *Sphagnum* mosses absent or very infrequent. ... **L**





Phase 2 Impact Survey: Blanket bog - trampling and grazing

Small-scale Field Indicators

-  Extent of ground cover by bryophytes and/or lichens among and between dwarf-shrub, sedge and grass plants.
- *Sphagnum* mosses and/or lichens absent or very patchy. “Feather” mosses may be abundant but if so then forming thin (<< 5 cm deep) mats. ... **H**
 - *Sphagnum* mosses and/or lichens present but patchy. “Feather” mosses, if present, forming thin to moderately deep mats and low hummocks (< 10 cm deep). ... **M**
 - *Sphagnum* mosses and/or lichens extensive and abundant. “Feather” mosses, if present, forming deep mats or low hummocks (> 10 cm deep). ... **L**
-  Abundance of hoof prints in bare peat over the assessment unit.
- Conspicuous and extensively present. Unmarked bare peat hard to find. ... **H**
 - Patchily present. Unmarked bare peat can be found after limited searching. ... **M**
 - Absent or very inconspicuous, extensive searching required to find hoof prints. ... **L**
-  Firmness of ground underfoot.
- Hard or firm over most of the bog surface. ... **H**
NB. Drainage and frequent burning can have similar effects.
 - Soft to very soft, spongy, over most of the bog surface. ... **M**
... **L**
-  Browsing of *Betula nana*.
- Heavily browsed. The majority of the most recent year’s shoots show signs of having been bitten. ... **H**
... **M**
 - Lightly to moderately browsed. The majority of the most recent year’s shoots show no signs of having been bitten. ... **L**
NB. Extrapolating to beyond 50 m of the bush may be unreliable.

Phase 2 Impact Survey: Blanket bog - trampling and grazing

Small-scale Field Indicators

-  Signs of browsing on *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Erica tetralix* or *Vaccinium vitis-idaea*.
- Some. ... **H**
NB. *Erica tetralix* is very rarely browsed. *Empetrum nigrum* is almost never browsed, although it may be damaged by trampling. If these species show extensive signs of browsing this is a good indication of heavy browsing and grazing in the immediately surrounding area.
 - None. ... **M**
L
-  Amount of flower or fruit on *Rubus chamaemorus*.
- Majority of shoots without flowers or fruit. ... **H**
NB. Check that lack of flowers or fruit is due to cropping. Lack of flowering sometimes may be due to other factors (check by looking for bitten stalks).
 - Majority of shoots flowering or fruiting (Fig. 30). ... **L**
-  Amount of flowering of *Eriophorum* spp.
- NB.* If little flowering was seen from a distance check that this was not due to a lack of plants.
- Little or none. Inconspicuous. ... **H**
 - Patchily abundant, or widespread but thinly scattered. ... **M**
 - Widespread and abundant. Very conspicuous and may give a colour cast to large areas of the bog. ... **L**
-  Growth-form and evidence of browsed shoots on *Myrica gale* bushes.
- Browsed shoots conspicuous and easy to find. Dense branching; branches/shoots are stopped and growth of main axes changes direction every 1 - 2 cm; or, 1 - 2 year old suckers, which may be several decimetres long, and relatively unbranched. Any extensive browsing into old woody shoot material beyond current year's growth. ... **H**
NB. Do not confuse side shoots growing off main branch axes with changes in direction of growth of main axes.

Phase 2 Impact Survey: Blanket bog - trampling and grazing

Small-scale Field Indicators

- Browsed shoots easy to find but not immediately conspicuous. Variably dense branching: some branch axes change direction every 1 - 2 cm but others grow for > 5 cm without change in direction. ... **M**
- Browsed shoots difficult to find or absent. Even, regular branching with most branches/shoots growing without change in direction for > 5 cm. ... **L**



Conspicuousness of browsing on *Calluna vulgaris* or *Vaccinium myrtillus*.

NB. See also **Dwarf-shrub heath** indicators.

- Clearly browsed in general appearance though the browsing may be patchy. Browsed shoots easy to find. ... **H**
M
NB. Particularly if being browsed in summer and/or if browsing into older, woody shoot material.
- Not obviously browsed. Browsed shoots difficult to find without both intensive and extensive searching. ... **L**



Amount of herbivore dung present.

- Easy to find, though may not be immediately conspicuous. ... **H**
M
NB. Dung will be difficult to find in taller vegetation.
- Rare and very difficult to find, or absent. ... **L**

Trend Field Indicators



Changes in growth form recorded within the structure of dwarf-shrub bushes.

- Upper surface of canopy largely stripped of upright green shoots - giving it a “tattered” or “worn” appearance - but the bush structure is open, regularly branching, and relatively upright. It should be easy to see into the centre and lower parts of bushes without parting branches. ... **I**

Trend Field Indicators

NB. If the change has been from light to moderate then these characteristics will be less clearly observable and are also likely to be patchy in occurrence.

- Lower, older parts of stems more contorted and/or densely branched than more recent parts. A relict “browse line” of old clipped shoot tips within the bush may be observable. ... **D**



Height of *Myrica gale*.

- Vigorous and tall, > 50 cm. ...**CL**
- Suppressed, short, < 50 cm. ...**CH**
CM

NB. Short *Myrica* may also be produced by short-term heavy browsing.



Height and cover of dwarf-shrubs relative to graminoids.

- Dwarf-shrub plants short (< 10 cm) and overtopped by leaves of graminoids which also have greater ground cover. ...**CH**
NB. *Eriophorum* spp. sometimes may be as, or more, abundant than dwarf-shrubs in the absence of heavy grazing and browsing.
- Dwarf-shrub plants moderately tall (> 10 cm) with height and cover comparable to, or greater than, graminoids. ... **D**



Abundance of *Juncus squarrosus* and its growth relative to other vegetation components.

- *Juncus squarrosus* conspicuous, frequent, and competing vigorously with other plants where the vegetation has been kept very short. ...**CH**
- *Juncus squarrosus* plants may be conspicuous and frequent but becoming overgrown around their edges by other plants (Fig. 31). ... **D**



Presence of species more typical of drier grassland such as *Agrostis canina*, *Agrostis capillaris*, *Anthoxanthum odoratum*, *Deschampsia flexuosa*, *Festuca ovina* and *Nardus stricta*.

- Frequent, possibly abundant. ...**CH**
- Sparse or absent. ...**CL**

Trend Field Indicators



Carex panicea abundant on drier “ridge” elements of bog patterning.

NB. *Carex panicea* may be abundant in water-tracks and flushes regardless of grazing and trampling pressure.

- Extensive, imparting a blue-green/whitish-green colour to “ridges”. ...CH
- Sparse or absent, not giving a blue-green/whitish-green colour to “ridges”. ...CL

Wind-clipped summit heath

Grazing and trampling

Pollution.

Deposition of nitrogen pollutants from the atmosphere may affect vegetation composition in a similar way to dung from grazing animals. This makes field diagnosis of causes of vegetation change more difficult. This could be significant in upland areas south of the Great Glen, particularly parts of the Cairngorms, south-west Highlands and the Southern Uplands.

Geographical applicability of indicators

Species mentioned may not all be present. *Alchemilla alpina*, *Armeria maritima*, *Minuartia sedoides*, *Sibbaldia procumbens*, and *Silene acaulis* occur sparsely in this habitat and are all absent from the Southern Uplands.

Small-scale Field Indicators



Signs of grazing on the leaves of *Carex bigelowii*, *Juncus trifidus* or fine-leaved grasses such as *Deschampsia flexuosa*, *Festuca ovina*, and *Festuca vivipara*.

- Easily observable. Signs of grazing on > 10 % of green leaves. ... **H**
- Very little or no signs of grazing, < 10 % of green leaves grazed. ... **L**



Extent, location and size of patches of bare ground (not gravel) and breaks in the vegetation mat.

NB. In areas repeatedly exposed to wind blasting there will be extensive bare areas among the vegetation. These often take the form of parallel stripes of bare, stony or gravel-strewn ground running at right angles to the direction of the prevailing wind. At very high altitudes, above 1000 m, the climate can be so severe that only patchy vegetation can

Phase 2 Impact Survey: Wind-clipped heath - grazing, trampling

Small-scale Field Indicators

become established so the relationship of bare ground to exposure may be less clearly observable than at slightly lower altitudes. The local prevailing wind direction can be judged from the direction of growth of the shoots and stems of any dwarf-shrubs or *Racomitrium* present and also by the more luxuriant growth of plants growing in the lee of boulders.

- In areas sheltered from the prevailing wind, patches about 10 cm across. ... **H**
- Predominantly on parts of the hill most exposed to the prevailing winds, variable size. Very little bare ground elsewhere. ... **L**



Amount of dung of sheep and/or Red Deer.

NB. Dung can be relatively abundant in resting areas, and areas which provide shelter, without these areas necessarily being heavily grazed. However, trampling and dunging impacts will still occur in these areas.

- Easily and frequently seen with > 3 groups of dung pellets 100 m⁻², or > 5 dung pellet groups 100 m⁻² where sheep only are present. ... **H**
- Sparse or absent, < 3 groups of pellets 100 m⁻² for sheep plus deer dung, or < 5 dung pellet groups 100 m⁻² if only sheep are present. ... **L**



Amount of dung of Mountain Hare.

- Densities of individual dung pellets > 300 100 m⁻². ... **H**
- Densities of individual dung pellets < 300 100 m⁻². ... **L**



Signs of grazing on the leaves of *Agrostis capillaris*, *Agrostis vinealis*, *Anthoxanthum odoratum*, or *Poa* spp. (look in hollows and sheltered spots).

- Majority of leaves closely grazed. ... **H**
- Majority of leaves not closely grazed, or infrequent signs of grazing of the leaves. ... **L**

Phase 2 Impact Survey: Wind-clipped heath - grazing, trampling

Small-scale Field Indicators



Browsing of any dwarf-shrubs present.

NB. See **Dwarf-shrub heath** for indicators.

- Noticeable, but not necessarily conspicuous. Moderately to heavily browsed. ... **H**
- Negligible, browsed shoots very difficult to find. ... **L**



Signs of grazing on *Armeria maritima*, *Alchemilla alpina*, *Minuartia sedoides*, *Sibbaldia procumbens*, or *Silene acaulis*.

- More than very occasional evidence. ... **H**
- Little or no signs of grazing. ... **L**



Where the ground is terraced, whether the face or the flat ground at the foot of terraces shows bare soil.

NB. Do not class gravel as bare soil.

- Both face and foot of some terraces. Bare soil rubbed and trampled. Strands of wool or hair caught on the ground surface may also be conspicuous. ... **H**
- Either the face or the foot, but not both, of some terraces. ... **L**

Trend Field Indicators



Collective cover of *Galium saxatile* and *Potentilla erecta*, fine-leaved grasses such as *Deschampsia flexuosa*, *Festuca ovina*, and *Festuca vivipara*.

- > 10 % of the vegetation cover in total (> 20 % on lime-rich substrates). ... **CH**
- As previous AND other indicators suggest light usage. ... **D**
- < 10 % of the vegetation cover in total (< 20 % on lime-rich substrates). ... **CL**
- As previous AND other indicators suggest heavy usage. ... **I**

Phase 2 Impact Survey: Wind-clipped heath - burning

Trend Field Indicators



Collective cover of broad-leaved grasses such as *Agrostis capillaris*, *Agrostis vinealis*, *Anthoxanthum odoratum* or *Poa* spp.

- More than negligible. ... **CH**
- As previous AND other indicators suggest light usage. ... **D**
- Negligible or absent. ... **CL**
- As previous AND other indicators suggest heavy usage. ... **I**

Burning

Field Indicators



Signs of burning.

- Any sign of burning at all. ... **H**

Dwarf-shrub heath

Browsing

Geographical applicability of indicators.

Species mentioned may not all be present. *Arctostaphylos uva-ursi* is scarce in the Southern Uplands and Northern Isles. *Myrica gale* is restricted to flushes, wet heaths and bogs. *Dryas octopetala* is only found on lime-rich substrates; it is scarce in the Northern Isles and absent from the Southern Uplands and Western Isles.

Small-scale Field Indicators



Signs of browsing on *Arctostaphylos uva-ursi*, *Empetrum nigrum*, *Erica tetralix* or *Vaccinium vitis-idaea* (or associated *Nardus stricta*)

- Some. ... **H**

NB. *Erica tetralix* is very rarely browsed. *Empetrum nigrum* is almost never browsed, although it may be damaged by trampling. If these species show extensive signs of browsing this is a good indication of heavy browsing and grazing in the immediately surrounding area. Occasionally, localised heavy browsing of these species may occur if snow cover makes most other forage unavailable, even when browsing is otherwise light. Other associated unpalatable species such as *Nardus stricta* can have similar indicator value (see Fig. 46).

- None. ... **M**

L



The average proportion of long-shoots of *Calluna vulgaris* and/or *Vaccinium myrtillus* showing signs of having been browsed.

(a) Where plants are more than moderately vigorous (average shoot growth $> 4 \text{ cm yr}^{-1}$).

- $> 66 \%$. Browsing very conspicuous, difficult to find unbrowsed shoots. ... **H**

- 33% - 66% . Clearly browsed in general appearance though effects may be patchy. ... **M**

Phase 2 Impact Survey: Dwarf-shrub heath - browsing

Small-scale Field Indicators

- < 33 %. Not obviously browsed, but browsed shoots found after some searching. ... **L**
(b) Where plants are less than moderately vigorous (average shoot growth < 4 cm yr⁻¹).
- > 33 % ... **H**
- 16 % - 33 %. Browsed shoots found after intensive and extensive searching. ... **M**
- < 16 %. Browsed shoots very difficult to find. ... **L**



Amount of flower or fruit on *Calluna vulgaris* and/or *Vaccinium myrtillus*.

NB. The abundance of flowering shoots of *Calluna vulgaris* and *Vaccinium myrtillus* can give an indication of rates of shoot removal, provided the seasonal pattern of browsing is known. If browsing only occurs in winter then new flowering shoots can be produced during the following summer, but if heavy browsing occurs during the summer most flowering shoots will be removed. The amount of flowering is also affected by weather patterns and can vary substantially from year to year irrespective of browsing impacts.

- Sparse. ... **H**
- Obvious but patchy. ... **M**
- Abundant and conspicuous. ... **L**



Summer browsing of *Calluna vulgaris*.

- Extensive, obvious, easy to find. ... **H**
- Very limited, patchy, negligible. Though infrequent may still be obvious due to removal of flowering shoots. ... **M**
L



Type of shoot material removed from *Calluna vulgaris* and/or *Vaccinium myrtillus*.

- Frequent evidence of browsing of woody shoot material older than the most recent year's growth. ... **H**
- Little or no browsing of woody shoot material older than most recent year's growth. Mainly shoot tips removed. ... **M**
- Only tips of shoots browsed. ... **L**

Phase 2 Impact Survey: Dwarf-shrub heath - browsing

Small-scale Field Indicators



Growth-form and evidence of browsed shoots on *Myrica gale* bushes.

- Browsed shoots conspicuous and easy to find. Dense branching: branches/shoots are stopped and growth of main axes changes direction every 1 cm - 2 cm; or, 1 - 2 yr old suckers, which may be several decimetres long, and relatively unbranched. Any extensive browsing into old woody shoot material beyond current year's growth. ... **H**
NB. Do not confuse side shoots growing off main axes with changes in direction of growth.
- Browsed shoots easy to find but not immediately conspicuous. Variably dense branching: some branch axes change direction every 1 cm - 2 cm but others grow for > 5 cm without change in direction. ... **M**
- Browsed shoots difficult to find or absent. Even, regular branching with most branches/shoots growing without change in direction for > 5 cm. ... **L**



Uprooting of dwarf-shrub seedlings in recently burnt patches.

- Conspicuous. ... **H**
- Not conspicuous, but possible to find with limited searching. ... **M**
- Little or none. ... **L**







Stem breakage as a result of trampling by larger herbivores (check for hoof prints).

- Conspicuous, > 50 m from supplementary feeding locations. ... **H**
NB. Conspicuous amounts of stem breakage are common in the immediate vicinity of supplementary feeding locations, or other locations where animals become unusually concentrated, even when average herbivore densities are low.
- Inconspicuous, except < 50 m from supplementary feeding location. ... **M**
L

Phase 2 Impact Survey: Dwarf-shrub heath - browsing

Small-scale Field Indicators

-  Depth of carpet of mosses and liverworts, or “bushy” *Cladonia* lichens, under and between the dwarf-shrubs.
- Thin < 5 cm deep, and patchy. ... **H**
... **M**
- NB.* Can also be reduced by intense or frequent fires.
- Thick and luxuriant > 10 cm deep, extensive. ... **L**
-  Amount of trampled, bare ground.
- Frequent, especially in recently burnt patches. ... **H**
- NB.* Heavily burnt patches may have much bare ground for the first 1 - 2 yrs after burning, regardless of browsing and trampling.
- Little or none except for sporadic sheep scars, or scrapes by hares or rabbits, or in recently burnt patches (and then only sporadic). ... **M**
... **L**
-  Amount of herbivore dung present.
- NB.* Dung can be relatively abundant in resting areas, and areas which provide shelter, without these areas necessarily being heavily grazed.
- Very conspicuous. ... **H**
 - Not very conspicuous but easy to find. ... **M**
- NB.* Dung will be difficult to find in taller vegetation.
- Rare and very difficult to find, or absent. ... **L**
-  Presence of spiders' webs in vegetation during July and August.
- Sparse. ... **H**
... **M**
 - Abundant, conspicuous. ... **L**

Trend Field Indicators



Growth-forms of *Calluna vulgaris* and/or *Vaccinium myrtillus*.

- “Drumstick”, “topiary”, or “carpet” growth forms of *Calluna vulgaris* widespread and easy to find (Figs. 32 - 34). Dwarf-shrub canopy shallow but dense: difficult to see beyond its surface from above without parting branches (Fig. 35). Shoots and branches contorted (Fig. 36) and intertwined. *Erica cinerea* plants reduced to short “brush-like” or “carpet” growth forms, occasionally “drumstick”-like forms, although this is variable. *Vaccinium myrtillus* densely branched, though if stems are very short (< 10 cm) branching may not be very obvious except within the moss and litter layer.

...CH

NB. Occasional bushes with these growth-forms can occur even when browsing is not heavy. Some bushes seem to be inherently attractive to browsers and they may be much more heavily browsed than their neighbours.

NB. “Carpet” growth forms of *Calluna vulgaris* can occur in very exposed situations, at high altitudes (usually above 600 m) or near the coast, even when browsing is not heavy. In similar situations *Vaccinium myrtillus* may occur as small, erect shoots within a short carpet of vegetation. Check for evidence of browsed shoots.

NB. Tall drumstick-like *Calluna vulgaris* can occur on wet heaths, particularly in western areas where *Calluna vulgaris* is growing with *Molinia caerulea*, even where browsing is moderate or light. Check for evidence of browsed shoots and contorted shoot growth.

NB. Care should be taken not to confuse these growth-forms with bushes which are genetically more spreading or prostrate in the way they grow (check for browsed shoots).

- “Drumstick”, “topiary”, or “carpet” growth forms of *Calluna vulgaris* localised and infrequent. *Vaccinium myrtillus* forming compact and much-branched bushes.

..CM

NB's. See above.

Phase 2 Impact Survey: Dwarf-shrub heath - browsing

Trend Field Indicators

- Upright growth of *Calluna vulgaris* and *Vaccinium myrtillus* with regular but infrequent branching. Possible to look quite deeply into the centre of bushes from above without parting branches (Figs. 37 - 38). Very few or no instances of “drumstick”, “topiary”, or “carpet” growth forms. ...CL



Changes in growth form recorded within the structure of dwarf-shrub bushes.

- Upper surface of canopy largely stripped of upright green shoots - giving it a “tattered” or “worn” appearance - but the bush structure is open, regularly branching, and relatively upright. It should be easy to see into the centre and lower parts of bushes without parting branches. (Figs. 39 - 40) ... I
NB. If the change has been from light to moderate then these characteristics will be less clearly observable and are also likely to be patchy in occurrence.
- Lower, older parts of stems more contorted and/or densely branched than more recent parts. A relict “browse line” of old clipped shoot tips within the bush may be observable. ... D



Presence of “drumstick”, “topiary” and “carpet” growth-forms.

- Extensive, well-developed. ...CH
NB. Likely to indicate decades of heavy browsing.
- Extensive but recent growth less contorted and growth-form becoming less well-defined. ... D
- Scattered, variably developed. ... I



Height and cover of dwarf-shrubs relative to graminoids.

- Dwarf-shrubs reduced to short stems (< 10 cm), shorter and of much lower ground cover than graminoids. *Calluna vulgaris* absent or very sparse but very short sprigs of *Vaccinium myrtillus* may be extensive. *Juncus squarrosus* may be conspicuously frequent if the vegetation has been kept very short. ...CH
NB. Indicates long-term heavy browsing over decades.

Phase 2 Impact Survey: Dwarf-shrub heath - browsing

Trend Field Indicators

- Dwarf-shrub plants are frequent and moderately tall (> 10 cm), and are slightly shorter than, equal to, or taller than the graminoids and of variable ground cover. *Calluna vulgaris* absent or sparse. *Juncus squarrosus* may be conspicuously frequent but the plants are likely to be overgrown around their edges by the rest of the vegetation. ... **D**

NB. Indicates recent reduction in browsing after decades of heavy browsing.

- *Myrica gale* vigorous and tall, > 50 cm. ... **CL**

NB. If > 1 m then light browsing for at least 5 yrs. Plants may be tall if heavy browsing only recently established (check for browsed shoots). Currently lightly browsed plants may be short if recently burnt (check for charred stems), or because of previous heavy browsing.



Sheep scars.

- Actively eroding. ... **CH**
I
- Revegetating. ... **D**

Burning: intensity of impact

Geographical applicability of indicators.

Species mentioned may not all be present. *Cytisus scoparius* is scarce in parts of north-west Scotland. *Lycopodium clavatum* and *Vaccinium uliginosum* are scarce or absent in the Southern Uplands and Western Isles.

Small-scale Field Indicators



Degree of combustion or “cooking” of the surface and upper layers of the soil (excluding loose, semi-decomposed plant litter).

- All or part of the surface layers of the soil consumed. Surface lumps of unconsumed humus or peat are likely to be solid and have a rubbery texture or brittle, bituminous crust, which may be water-repellent. ... **H**
- Only surface scorching and only in small scattered patches (generally < 1 m² in size) mostly immediately around formerly large, mature *Calluna vulgaris* bushes. ... **M**
NB. In wet heath the litter under bushes can remain damper than the litter between bushes and hence the latter is *sometimes* more likely to be consumed.
- No burning or scorching of the soil surface. ... **L**



Amount of ash, and the amount and size of charcoal fragments immediately after burning.

- Conspicuous covering of ash over most of the ground surface. ... **H**
NB. After a very intense fire ash may form drifts.
- Only small patches of ash scattered over the ground surface, though charcoal and heavily charred woody material ubiquitous and abundant. ... **M**
- Little ash, even immediately after burning, but much lightly charred woody material. ... **L**



Degree of combustion of above-ground woody material.

- Complete or almost complete combustion of woody material. ... **H**

Phase 2 Impact Survey: Dwarf-shrub heath - burning intensity

Small-scale Field Indicators

- Most of the twigs in the canopy consumed but most of the thicker stem material only superficially charred. ... **M**
- Mostly only superficial charring, with much material unburnt. Only the finest shoots consumed. Occasional dwarf-shrub stems merely scorched or missed entirely by the fire. (Figs. 41 - 42) ... **L**



Degree of combustion of plant litter, mosses and lichens.

- Extensive complete combustion or severe charring over > 50 % of the area. ... **H**
- Patchy consumption over < 50 % of the area, mostly as small scattered patches (generally < 1 m² in size) under large, mature *Calluna vulgaris* bushes. The surface of any cushions of *Sphagnum* and/or *Leucobryum glaucum* conspicuously bleached regardless of size, and difficult to find live tissue within 10 mm of the cushion surface, especially in cushions < 1 m wide. ... **M**
- Very patchy and light scorching of plant litter or mosses. Any cushions of *Sphagnum* and/or *Leucobryum glaucum* > 1 m wide unbleached except around their edges. The surface of cushions < 1 m wide may be conspicuously bleached but it is easy to find live tissue within 10 mm of the cushion surface. ... **L**



Amount of regeneration and whether from seed or resprouting stems.

NB. You need to know when the fire occurred to use this indicator.

- Dwarf-shrubs, herbs and other higher plants infrequent till many years (5 - 10 yrs) after burning. ... **H**
- Regeneration of dwarf-shrubs only from seed (Fig. 43) or not at all. ... **H**

NB. Species with underground rhizomes (e.g. *Pteridium aquilinum*, *Vaccinium myrtillus*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*) likely to survive and regenerate well if only the top few mm of the soil have been consumed.

Phase 2 Impact Survey: Dwarf-shrub heath - burning intensity

Small-scale Field Indicators

- Abundant regeneration of dwarf-shrubs and other higher plants, from both seedlings and stem sprouts or rhizome sprouts, within 5 yrs of the fire. ... **M**

NB. Regeneration by seedlings is most likely in the parts of the patch where the soil surface has been bared. Seedling regeneration of dwarf-shrubs may fail or be delayed if there have been prolonged dry spells during the first one or two post-fire growing seasons. Young seedlings can also be killed by frost-heave.

- Little or no seedling regeneration of any plants species. ... **L**

NB. Regeneration of dwarf-shrubs by resprouting from stem bases may sometimes also be weak, particularly if *Calluna vulgaris* had thick stems (> 5 mm diameter at the base).



Survival of clubmosses and *Blechnum spicant*.

- Clubmoss plants and *Blechnum spicant* plants severely scorched, all or most plants dead. ... **H**

- Parts of plants survive where insulated by unburnt mosses and litter (good survival of *Blechnum spicant* and *Diphasiastrum alpinum*, but living *Lycopodium clavatum* plants much reduced in size). (Fig. 44) ... **M**

- Clubmoss plants and *Blechnum spicant* plants little scorched during burning. The majority of *Lycopodium clavatum* plants surviving with only modest reduction in size. ... **L**



Effects of fire on any bushes and trees within the dwarf-shrub stand.

- Trees, saplings and bushes all killed. ... **H**

NB. *Betula* seedlings may establish abundantly after fire wherever good seed-bed conditions are produced near to seed bearing trees.

- Occasional trees surviving, saplings and bushes mostly killed. ... **M**

- Trees, saplings and bushes mostly surviving either little damaged or vigorously resprouting from stem bases. ... **L**

Burning: frequency of fires

Geographical applicability of indicators.

Species mentioned may not all be present. *Anemone nemorosa* is scarce or absent in the Northern Isles and Western Isles. *Campanula rotundifolia* is scarce in parts of north-west Scotland. *Genista anglica* and *Trientalis europaea* are scarce or absent in the Southern Uplands, western Scotland and the Northern Isles. *Lathyrus linifolius* is scarce in the Northern Isles. *Lycopodium clavatum* are scarce in the Western Isles. *Pyrola media* is scarce or absent in the Southern Uplands, western Scotland and the Northern Isles. *Vaccinium uliginosum* is scarce or absent in the Southern Uplands and Western Isles. *Myrica gale* is restricted to flushes, wet heaths and bogs.

Small-scale Field Indicators



Relative abundance of different dwarf-shrub species.

- Rhizomatous dwarf-shrub species e.g. *Myrica gale*, *Vaccinium myrtillus*, *Vaccinium uliginosum*, *Vaccinium vitis-idaea*, much more abundant than non-rhizomatous species like *Calluna vulgaris* or *Erica* spp. ... **H**

NB. If fires have been very light this may also occur at moderate or low fire frequencies.

NB. It is not unusual for rhizomatous dwarf-shrub species to be more abundant in the first 5 - (10) yrs after burning, regardless of fire frequency.

- Non-rhizomatous species like *Calluna vulgaris* or *Erica* spp. as abundant or more abundant than rhizomatous dwarf-shrub species. ... **M**
L



Abundance of dwarf-shrub seedlings in the second to fourth year after burning.

- Abundant. Easy to find, some within nearly every 1m². (Fig. 43) ... **M**
- Very few or no seedlings. Not easy to find, most m²'s with none. ... **H**
L

Small-scale Field Indicators

NB. Seedlings are sensitive to droughting and may be killed by long dry periods, or by frost-heaving. Also, seedlings may be lacking because fires have been very heavy and have partially or completely destroyed the soil seed bank, or, they may be shaded out if vegetative regeneration is very dense and vigorous.



Variation in tallness of dwarf-shrub plants at small spatial scales of 10's m² to 100's m².

NB. Not in very recently burnt patches.

- Very uniform. Vegetation mostly relatively short (grasses and sedges < 30 cm, dwarf-shrubs < 15 cm. ... **H**

NB. Light fires can result in scattered bushes being left unburnt which can contribute to structural variation.

- Relatively uniform within patches but considerable variation between patches. Mostly < 30 cm tall. ... **M**
- Considerable variation within patches, with some plants up to 50 cm tall. May be large, mound-shaped, layering *Calluna vulgaris* bushes covering 1 m² - 2 m² each. ... **L**

NB. Layering of *Calluna vulgaris* and the development of spreading bushes may not occur in very dense, tall dwarf-shrub patches.



Structural dominance of dwarf-shrubs relative to graminoids.

- Dwarf-shrubs shorter and uniformly subdominant. ... **H**

NB. Heavy browsing of dwarf-shrubs (most likely in winter) will exacerbate this effect. Moderate to heavy summer grazing will affect the graminoids and make the dwarf-shrubs more visible.




NB. Dwarf-shrubs may be short if recently burnt. If remains of stem material are lacking or only of very small diameter (< 5 mm) this suggests frequent burning (or possibly a high intensity fire).

NB. In the first 1 - 3 yrs after burning *Deschampsia flexuosa* often becomes abundant and flowers conspicuously, regardless of frequency of burning.

- Dwarf-shrubs mostly of equal height and structural

Phase 2 Impact Survey: Dwarf-shrub heath - burning frequency

Small-scale Field Indicators

- dominance. ... **M**
 - Dwarf-shrubs mostly taller and dominant ... **L**
-  Extent and luxuriance of “feather” mosses, *Sphagnum* mosses, or liverworts under and between the dwarf-shrubs, and of epiphytic bryophytes, and lichens (e.g. *Hypogymnia physodes*) on the stems of the dwarf-shrubs.
- Sparsely present as thin mats (< 5 cm deep) represented by only 2 - 3 main species. ... **H**
 - Variably present, sometimes forming mats 5 cm - 10 cm deep, with > 3 spp. in at least one of the groups. Epiphytes possibly present but unlikely to be abundant. ... **M**
 - Abundant and diverse in a thick, though sometimes patchy, carpet > 10 cm deep, with > 3 spp. in at least one of the groups. Epiphytes probably present and may be abundant. ... **L**
(Fig. 45)
- NB.* These features may be poorly developed on dry, open, south-facing slopes at low altitudes below 600 m.
-  Abundance and luxuriance of “bushy” *Cladonia* lichens under and between the dwarf-shrubs.
- NB.* A feature most likely to show vigorous development in the north-east Highlands.
- Scarce or absent. ... **H**
 - Frequent but not very abundant. ... **M**
 - Abundant and conspicuous, particularly in more open patches (Fig. 29). ... **L**
-  Size of plants and colonies of clubmosses and/or *Blechnum spicant*.
- NB.* Likely to be absent or scarce if fires have been intense, regardless of their frequency. *Diphasiastrum alpinum* survives fire better than *Lycopodium clavatum*, having stems which tend to be more buried, and insulated, in the litter and soil.
- Small plants or colonies each << 1 m maximum width. ... **H**
 - Plants or colonies up to 1 m maximum width. ... **M**
 - Plants or colonies > 1 m wide. ... **L**

Phase 2 Impact Survey: Dwarf-shrub heath - burning frequency

Small-scale Field Indicators



Average density of vascular plant species within the assessment unit.

- High (> 5 spp. m^{-2} on average). ... **H**
NB. Except when fires are light.
- Moderately high (3 - 5 spp. m^{-2} on average). ... **M**
NB. Except when fires are light.
- Low (< 3 spp. m^{-2} on average). ... **L**



Abundance and diversity of forbs and grasses within the whole of the assessment unit: including some of *Agrostis capillaris*, *Anemone nemorosa*, *Antennaria dioica*, *Campanula rotundifolia*, *Deschampsia flexuosa*, *Festuca ovina*, *Galium saxatile*, *Genista anglica*, *Hypericum pulchrum*, *Lathyrus linifolius*, *Lotus corniculatus*, *Polygala serpyllifolia*, *Potentilla erecta*, *Pyrola media*, *Succisa pratensis*, *Trientalis europaea*, *Veronica officinalis*, and *Viola riviniana*.

NB. Forbs are most likely to be noticeably abundant and diverse over mineral soils.

- Conspicuous, as or more abundant than dwarf-shrubs. Many of the above species present (> 10 spp.). ... **H**
- Less abundant than dwarf-shrubs but still including many of the above species (> 10 spp.). ... **M**
NB. Herbs may not be a very conspicuous component of the vegetation, particularly in stands which have not been recently burnt. May require searching under the dwarf-shrub canopy.
- Herbs generally sparse and of low diversity. *Pyrola media*, or *Listera cordata* in wet heaths and boggy areas, may be fairly frequent but relatively inconspicuous under and among the dwarf-shrubs. ... **L**

NB. Two or three forb and grass species may be temporarily abundant during the first 5 - (10) yrs after fire even when burning is infrequent (e.g. *Deschampsia flexuosa*).

Phase 2 Impact Survey: Dwarf-shrub heath - burning frequency

Small-scale Field Indicators



Solidity and texture of the peat, or humus-rich, surface layers of the soil.

NB. May not be applicable on dry, predominantly mineral soils though a humus layer of several cm is always likely to be present.

- Solid, possibly somewhat “rubbery” textured or water-repellent. ... **H**

NB. Especially when also heavily burnt.

- Spongy or friable, not noticeably “rubbery” textured or water-repellent. ... **M**
L



Abundance and form of trees and shrubs, especially *Juniperus communis*.

NB. If no nearby parent plants (< 1 km) then effects may only indicate past elimination rather than present conditions.

- Very scarce, or absent. If present then only as small plants < 25 cm tall. ... **H**

NB. *Juniperus communis* plants may be small (but prostrate in form) at high altitudes and where it is very exposed, even where little or no burning occurs. Browsing may also produce this effect.

- Very scarce, or absent. If present then only as moderately small plants < 50 cm tall. ... **M**

NB. See above.

- Possibly abundant, well developed trees and saplings. ... **L**

NB. Only large-seeded, animal dispersed species such as *Sorbus aucuparia* and *Juniperus communis* are most likely to be frequent. Saplings may not obviously protrude above the dwarf-shrub canopy if they are browsed.

Trend Field Indicators



Abundance and dominance of graminoids.

- Very abundant and dominant in terms of both cover and height.

...CH

NB. Frequent burning over many decades.

NB. May also occur if dwarf-shrub regeneration fails *e.g.* for climatic reasons or because of heavy browsing.

Tussock grassland

Grazing

Vole grazing.

Severe disruption of the sward can occasionally occur as a result of grazing by voles, and the making of runs, beneath the snow in winter. Dense networks of runs are usually centred on patches where moderate, but not large, amounts of snow accumulate.

Geographical applicability of indicators.

Species mentioned may not all be present. *Festuca vivipara* is widespread but is only found at higher altitudes.

Small-scale Field Indicators



Signs of grazing on *Nardus stricta* tussocks, where sheep or Red Deer are the principal grazing animals.

- Bitten around the edges, or more extensively cropped (Fig. 46). ... **H**
- Virtually no evidence of grazing. ... **M**
... **L**



Signs of grazing on *Nardus stricta* tussocks, where cattle are the principal grazing animals.

- Extensive grazing of tussocks, which may be small and not very obvious. ... **H**
- Conspicuous but patchy grazing of tussocks with much ungrazed material. Tussocks conspicuous and well developed. ... **M**
- Little no signs of grazing. ... **L**



Average inter-tussock sward height.

- < 3 cm ... **H**
- 3 cm - 6 cm ... **M**
- > 6 cm ... **L**

Phase 2 Impact Survey: Tussock grassland - grazing

Small-scale Field Indicators



Accumulation of dead plant litter.

- Thin mat < 3 cm deep in the inter-tussock vegetation, plus obvious standing dead material in tussocks. ... **H**
- Mat (often mixed with mosses) 3 cm - 6 cm deep among inter-tussock vegetation. Obvious and abundant standing dead material in and around tussocks. ... **M**
- Deep, though possibly loose, layer > 6 cm deep. Standing dead material very obvious even among the inter-tussock vegetation. ... **L**



Signs of grazing of less palatable species (other than tussock-formers) such as *Juncus* spp., *Cirsium* spp. *Galium saxatile*, *Potentilla erecta*, mosses.

- Present. ... **H**
- Absent or virtually so. ... **M**
... **L**



Flowering of associated herbs in inter-tussock vegetation (June - August).

- Sparse or none. ... **H**
NB. Sheep, but not cattle, show some avoidance of grass flowering stems.
- Scattered but noticeable flowering shoots, but majority of plants and tillers not flowering. ... **M**
- Flowers collectively abundant and easy to find. ... **L**



Signs of grazing on leaves of (collectively) *Agrostis capillaris*, *Anthoxanthum odoratum*, *Danthonia decumbens*, *Deschampsia flexuosa*, *Festuca rubra*, *Holcus* spp., *Poa* spp. and sedges.

- All, or nearly all, leaves grazed. Difficult to find ungrazed leaves. ... **H**
NB. During the peak of the growing season the signs of grazing may be less obvious, particularly for species with relatively fast leaf turnover (e.g. *Agrostis* spp.).
- Obviously but not completely grazed, on average > 50 % of leaves grazed. Ungrazed leaves can be found without intensive searching. ... **M**
- < 50 % of leaves grazed. Ungrazed leaves easy to find. ... **L**

Phase 2 Impact Survey: Tussock grassland - grazing

Small-scale Field Indicators



Signs of grazing on leaves of (collectively) *Agrostis canina*, *Festuca ovina*, and *F. vivipara*.

- > 66 % of leaves grazed. General appearance will be that nearly all grass leaves are grazed. ... **H**
NB. During the peak of the growing season the signs of grazing may be less obvious. There may also be uprooted tillers of *Agrostis* and *Festuca* scattered over the sward surface.
- Variable but obvious grazing, on average 33 % - 66 % of leaves grazed. ... **M**
- Not obvious, < 33 % of leaves grazed. ... **L**



Signs of grazing on leaves of *Deschampsia cespitosa*.

- Present and easily observable without extensive searching. ... **H**
- More or less absent. ... **M**
L



Seedlings and saplings of trees and shrubs > 5 cm tall.

- Absent. ... **H**
M
NB. May be absent because there are no seed sources nearby (within several km) or the sward remains too dense to provide regeneration niches for seedlings.
- Present. ... **L**





Amount of bare ground.



- Easily observed, widespread, surface disturbed by hoof marks. ... **H**
NB. Do not attribute to heavy grazing bare ground caused by mole heaps, soil slippage, or rock falls.
- None or sparse, not easily observed. ... **M**
L

Phase 2 Impact Survey: Tussock grassland - grazing

Small-scale Field Indicators

-  Cover of mosses, particularly *Polytrichum commune* and “feather” mosses such as *Pleurozium schreberi* and *Hylocomium splendens*.
- High cover, a dominant and easily observed component of the vegetation (and grass shoot density likely to be relatively low). ... **H**
NB. May be a legacy of a past episode of heavy grazing by voles or livestock.
 - Present, and relatively easily observed, but not a dominant or immediately obvious component of the vegetation. ... **M**
L
-  Presence of spiders’ webs in the vegetation during July and August.
- Sparse ... **H**
M
 - Abundant and conspicuous. ... **L**

Trend Field Indicators

-  Grazing impact indicated by inter-tussock sward height relative to grazing impact deduced from signs of grazing on plants.
- By sward height < by signs of grazing on leaves and flowers. ... **I**
 - By sward height > by signs of grazing on leaves and flowers. ... **D**
-  Degree of flowering and vegetative state of potentially taller herbs *e.g.* *Succisa pratensis* (see also **Tall herbs**).
- NB.* Tall herbs may not be present. Even if they are present nearby and grazing is reduced to low intensities they are slow to invade unless suppressed plants are present in the sward.
- Plants dwarfed (leaves may be less than half normal size). ... **CH**
 - Plants well developed and not obviously dwarfed. ... **CL**
 - Plants not obviously dwarfed but both leaves and flowering shoots grazed. ... **I**
 - Plants dwarfed but flowering, with little evidence of grazed leaves or flowering shoots. ... **D**

Phase 2 Impact Survey: Tussock grassland - grazing

Trend Field Indicators



Abundance and relative growth of *Juncus squarrosus* and other small, rosette-forming, creeping or mat-forming herbs (e.g. *Galium saxatile*, *Polygala serpyllifolia*, *Potentilla erecta*, *Viola palustris*), or dwarfed plants of taller growing species, in the inter-tussock vegetation.

- Major and conspicuous component, not being overgrown by other components of the vegetation. ...CH
 - Being overgrown, abundant or not. ...D
 - Low cover and/or frequency. Sward is very much dominated by grasses, and possibly bryophytes. ...CL
- NB.* Occasional tall herb plants may be conspicuous. These species can sometimes become patchily dominant.



Cover of mosses, particularly *Polytrichum commune* and “feather” mosses such as *Pleurozium schreberi* and *Hylocomium splendens* versus what is deduced from other indicators.

- High cover, very obviously a major component of the sward AND other indicators suggest moderate or light grazing. ... D







Presence of tree and shrub saplings versus sward height.

NB. May be absent because there are no seed sources nearby (within several km) or the sward remains too dense to provide regeneration niches for seedlings.

- Present (small saplings may show signs of browsing) AND inter-tussock sward short. ... I

Burning: intensity of impact

Small-scale Field Indicators

-  Degree of combustion or “cooking” of the surface and upper layers of the soil (excluding loose, semi-decomposed plant litter).
- Any burning or scorching of the soil surface. ... **H**
 - No burning or scorching of the soil surface. ... **M**
... **L**
-  Amount of charcoal and ash immediately after burning.
- Most of the ground surface covered with fine charcoal and ash, very little or no unburnt or uncharred surface vegetation or plant litter. ... **H**
 - Fine charcoal and ash patchily distributed over the surface with uncharred vegetation or plant litter visible. ... **M**
 - Surface lightly speckled with fine charcoal and ash with more than half the vegetation and plant litter remaining uncharred. ... **L**
-  Degree of combustion of grass tussocks.
- NB.* Care should be taken to distinguish between destruction of tussock material by combustion and destruction by other post-fire factors *e.g.* heavy grazing and trampling by livestock.
- Destruction of all standing leaf material and leaf litter and some or all of the basal internodes of the plants killed or consumed in most tussocks. Tussocks reduced in size. ... **H**
 - Destruction of most of the standing leaf material and leaf litter but basal internodes of the plants survive virtually unscathed in most tussocks. ... **M**
 - Much of the standing leaf material and litter remains unconsumed or partially consumed and basal internodes of the plants are completely unaffected (Fig. 47). ... **L**
-  Effects of fire on any bushes and trees present.
- Most trees, saplings and bushes killed. ... **H**
- NB.* *Betula* seedlings may establish abundantly after fire wherever good seed-bed conditions are produced near to

Phase 2 Impact Survey: Tussock grassland - burning intensity


Small-scale Field Indicators

seed bearing trees.

- Most trees surviving, saplings and bushes mostly killed. ... **M**
- Trees, saplings and bushes mostly surviving either little damaged or vigorously resprouting from stem bases. ... **L**


Burning: frequency of fires

Small-scale Field Indicators


-  Height of grasses relative to any dwarf-shrub plants present.

NB. Dwarf-shrub plants will be short during the first 5 yrs after burning regardless of burning frequency.
NB. Heavy grazing may result in relatively short dwarf-shrub plants.


 - Grasses very much taller. Dwarf-shrubs may be difficult to see without close examination among the grass tussocks. ... **H**
 - Grasses taller, but not overwhelmingly so. ... **M**
 - ... **L**
 - Grasses shorter. ... **L**

-  Amount of accumulated dead plant litter and senescence of tussocks.

 - Limited accumulation of dead material and litter. No senescence of tussocks except for any parts killed during burning. ... **H**
 - Litter layer up to about 10 cm deep, substantial accumulation of dead material in tussocks but no obvious signs of any dieback. ... **M**
 - Deep litter layer and much accumulated standing dead material (*excluding* tussock cores), > 10 cm deep, equalling or exceeding amount of green material even in the summer. Some tussocks may show signs of dieback. ... **L**

-  Size of tussock cores (*i.e.* the dense core material, excluding the spread of leaves).

 - Majority small, < 10 cm diameter ... **H**
 - Majority large, > 10 cm diameter. ... **M**
 - ... **L**

-  Diversity of herbs other than tussock-forming dominants.

 - ≥ 4 spp., making a substantial contribution to the vegetation. ... **M**
 - Very few, < 4 spp., making little contribution to largely monospecific vegetation. ... **H**
 - ... **L**

Small-scale Field Indicators



Abundance and form of trees and shrubs.

NB. If no nearby (< 1 km) parent plants then effects may only indicate past elimination rather than present conditions, or a lack of regeneration niches in a continuously closed sward.




- If present then only seedlings. (Probably absent.) ... **H**
- If present then only as small plants less than 25 cm tall. (Probably scarce.) ... **M**
- Well developed trees and saplings. ... **L**

NB. Large-seeded, animal dispersed species such as *Sorbus aucuparia* and *Juniperus communis* are most likely to be frequent. Saplings should not show any evidence of recent resprouting from the base, in response to recent fire damage. Note that heavy browsing may produce basal resprouting in the absence of fire. Saplings may not obviously protrude above the dwarf-shrub canopy if they are browsed.

Bracken

Vigour

Small-scale Field Indicators

	Evidence of disease or damage to fronds.
•	Green, unblemished and moderately leathery. ... H
•	Only occasional marks or yellowing. ... M
•	Uneven yellowing or browning of the fronds during the growing season, possibly with curling and /or blackening of the frond apex and possibly also the tips of the frond segments. ... L
•	Black specks, c. 0.5 mm diameter, in dense patches 1 cm - 2 cm across, on the main rib and stem of the frond, which may develop into elongated brown “eyespot” with a grey centre of dead tissue. ... L
•	Fronds shrivelled, dried, brittle, with partial die-back before full expansion. ... L
•	Fronds broken at ground level without any evidence of livestock trampling (no dung or hoof marks). ... L
•	“Tattered” or “shredded” appearance; possibly substantial breakage and flattening of the fronds. ... L
	Frond height when fully expanded in late July and August.
	<i>NB.</i> Very tall (> 2 m) but otherwise weak fronds may be occur in dense shade.
•	> 100 cm. ... H
•	50 cm - 100 cm. ... M
•	< 50 cm tall. ... L
	Average basal diameter of fronds.
•	> 8 mm. ... H
•	5 mm - 8 mm. ... M
•	< 5 mm. ... L

Phase 2 Impact Survey: Bracken - vigour

Small-scale Field Indicators



Average frond density in patches.

- 25 m^{-2} - 64 m^{-2} on average (5 m^{-1} - 8 m^{-1} of line transect). ... **H**
- 9 m^{-2} - 25 m^{-2} or 64 m^{-2} - 100 m^{-2} (3 m^{-1} - 5 m^{-1} of line transect). ... **M**
- $< 9 \text{ m}^{-2}$ ($< 3 \text{ m}^{-1}$ of line transect). ... **L**



Size of patches of uniform, unbroken canopy (summer) or frond litter (winter) produced by dense aggregations of fronds (this may be difficult to observe).

NB. This may sometimes be unclear or difficult to apply.

- $> 10 \text{ m}$ minimum width. ... **H**
- 1 m - 10 m minimum width. ... **M**
- $< 1 \text{ m}$ minimum width. ... **L**



Average depth and continuity of frond litter.

- $> 20 \text{ cm}$, continuous. Few other plant species present. ... **H**
- 10 cm - 20 cm , patchy and broken in places. Sparse to moderately frequent presence of other plant species. ... **M**
- $< 10 \text{ cm}$, discontinuous, possibly sparse. Well developed “field layer” of other plant species. ... **L**

Trend Field Indicators



Vigour class by litter depth versus vigour class by other indicators.

- By litter depth $<$ by other indicators. ... **I**
NB. The patch also may be slowly increasing in size. This is more likely to be the case if the patch is an extension of a parent patch of vigorous bracken.
- By litter depth $>$ by other indicators. ... **D**
NB. May be temporary. The boundaries of the area, within which some fronds occur, are unlikely to change quickly.

Phase 2 Impact Survey: Bracken - vigour

Trend Field Indicators



Identity and vigour of associated plant species growing under the bracken.

- Weak, dying, or dead. ... **I**
NB. Light demanding species like *Calluna vulgaris* are likely to be first affected. *Vaccinium myrtillus* and vernal plants will persist for longest.
- Vigorous plants of dwarf shrubs, or other plants, under which can be found the remains of old bracken litter. ... **D**
NB. Particularly indicative where light demanding species like *Calluna vulgaris* are involved.
- Rushes or bog mosses present. ... **S**
D
NB. Likely to decline if waterlogging is increasing in intensity or frequency.



Form of boundary between bracken and other vegetation.

- Sharp boundary (< 1 m wide). ... **S**
- Diffuse, wide boundary (> 1 m wide). ... **I**
D

Part 4: Additional impact types and aids to identifying impact agents

Field indicators for types of peat cutting and drainage

M = Milling; **E** = Extrusion of peat “sausages”; **B** = Baulk & Hollow machine cutting; **H** = Hand cutting; **G** = Grips; **F** = Forestry drainage.



Form of drainage.

NB. Drains and ditches may be larger than indicated if scouring and erosion has occurred. They may be smaller if revegetation and infilling has occurred.

- Drains 1 m wide, and 1.5 m deep, roughly 20 m apart with a gently cambered surface in-between. ... **M**
- Long, straight narrow slits, often < 2 cm wide, roughly 1 m apart. Sometimes with drains cut at 20 m intervals or at site margins. ... **E**

NB. Slits are more likely to be obvious in summer than in winter.

- Trenches 2.5 m wide and about 6.5 m apart. Narrow drains dug at right angles to each end of the trenches. ... **B**

NB. Trenches may also be formed by hand cutting as peat banks are created and the faces are progressively cut back in successive years.

- Long parallel drains 0.3 m deep, 0.5 m wide, spaced at 20 m - 30m intervals (but spacing can range can be 10 m - 50 m). Distinct spoil ridge (recent) up to 0.3 m high, or less distinct vegetated ridge along one side of the full length of the drain. Often in a herringbone pattern feeding into main drains or natural drainage channels. ... **G**
- Ploughed drains, up to 1 m deep, parallel and close-spaced (4 m spacing). ... **F**

Types of peat cutting and drainage



Surface characteristics produced by peat removal operations.

- Vegetation and peat stripped from extensive areas leaving a firm bare peat surface. ... **M**
... **E**
- Surface vegetation partially or completely destroyed. Scattered remnants of peat sods over the surface, cylindrical or 'sausage' shaped, 4 cm - 15 cm in diameter, variable length. ... **E**
- Peat cut out in blocks from trenches 2.5 m wide, separated by raised baulks (uncut ridges) 6.5 m wide. ... **B**
- Square, linear or gently curving banks producing two or more distinct levels. Upstanding dry baulks (ridges) with vertical sides adjacent to lower flat trenches or hollows from which the peat has previously been removed. Baulks often only 1 m wide separated by hollows up to 5 m². Hollows may be stepped where the surface has been reworked. Hollows and baulks may occur as single isolated features or a series of features across the bog. ... **H**

NB. Current cutting is easily identifiable in the summer: a vertical and sharp-edged peat bank adjoins a freshly cut often flooded hollow area, with 1 m - 2 m of exposed bare peat immediately below the bank face, and careful replacement of cut turfs from the bank surface over the rest of the hollow. (Sometimes, turfs are not replaced or carelessly replaced.) Peat sods are stacked on the baulk to dry. Old cuttings sometimes may not be easy to identify (although stepped peat structures are suggestive of past peat cutting).



Conspicuous damage by machinery passage or stacking of cut peat on the bog surface.

- Long parallel lines of browned and dead plant material and compacted peat from repeated passage of vehicles. Variable severity. ... **E**
- NB.* Machinery is increasingly used in other types of peat cutting.
- Baulks show signs of damage due to stacking peat along one edge, *i.e.* brown and dead vegetation, exposed bare peat and vehicle tracks. ... **B**

Field indicators to identify use by different herbivores

C = Cattle; D = Red deer; H = Hares; P = Ponies; R = Rabbits;
S = Sheep; V = Voles



Form of clipping of plants

- Very neat. Herbs may be reduced to a very short sward < 2 cm tall. Dwarf-shrubs tightly clipped into small spherical or tabular structures, often < 10 cm across. Extreme effects very localised (often only a few m² at a time). No stem breakage of woody plants. ...R
H

NB. Rabbit use is often concentrated within a few hundred metres of warrens. Hare use is more dispersed but areas often joined by conspicuous and characteristic paths.
- Less neat. Swards seldom reduced to < 3 cm. Dwarf-shrubs may be closely clipped but forming larger less regular structures, more widespread. Little stem breakage of woody plants, most likely to be noticeable around supplementary feeding sites. ... S
D
P
- Coarse herbage removal. Swards seldom reduced to < 6 cm. May be considerable stem breakage of woody plants. ... C



Characteristics of severed shoots

- Clean cut, usually oblique. ... R
H
V
- Fairly clean cut, not oblique. ... P
- Break or tear, often somewhat frayed, usually straight across. ... D
S

Use by different herbivores



Height at which most signs of browsing or grazing occur

- Mostly < 10 cm ... **V**
- Mostly < 30 cm ... **R**
- H**

NB. Hares and rabbits may browse taller material when snow provides access.

- 10 cm - 200 cm ... **D**
- C**
- 3 cm - 100 cm ... **S**
- G**



Height of dense vegetation, particularly of less palatable species, above which access and use by animals is reduced.

- > 35 cm ... **S**
- > 100 cm ... **D**
- C**
- P**



Dung pellet shape

- Cylindrical, rounded ends ... **V**
- Spherical ... **R**
- Flattened, spherical ... **H**
- Spherical, faceted ... **S**
- Cylindrical, often with one end pointed and the other rounded or concave. ... **D**



Dung pellet size (from mature animals)

- 6 mm - 7 mm long, 2 mm - 3 mm wide ... **V**
- 10 mm diameter ... **R**
- S**
- 15 mm - 20 mm diameter ... **H**
- 20 mm - 25 mm long, 13 mm - 18 mm wide. ... **D**



Dung pellet texture and aggregation pattern

- Variable texture, Occur in piles, in association with runs and latrines. ... **V**
- Somewhat fibrous, often in latrine areas. ... **R**
- Clearly fibrous. Small piles in feeding areas. ... **H**
- Not fibrous. Pellets deposited in compressed cylinders or clumps, dropped at random in feeding and resting areas. ... **S**

Use by different herbivores

- Usually in clumps rather than separate pellets, especially in summer, dropped at random in feeding and resting areas. ... **D**



Size of hoof prints (of mature animals)

- c. 6 cm long ... **S**
- c. 8 cm long ... **D**
- c. 10 cm long ... **C**



Paths

- Straight or gently curving for long stretches of several hundred metres, about 10 cm wide, neatly clipped back at the edges where they run through dwarf-shrubs and other taller vegetation, often running at a steep angle more or less straight up and down slopes. Surface not poached. ... **H**
- Straightness very variable, 15 cm - 20 cm wide (possibly up to 40 cm), not neatly clipped back at the edges, cross slopes at various angles but often at a shallow angle more or less following contours. Surface may be poached but no more than a few cm deep. ... **D**
... **S**
- When well developed often fairly straight for long stretches, wide > 40 cm, not clipped at the edges, mostly cross slopes are shallow angles, surface often deeply poached and muddy. ... **C**

Field indicators for damage by insects, fungi or weather

(applicable mainly to dwarf-shrub heath)

Geographical applicability of indicators.

Species mentioned may not all be present. *Arctostaphylos uva-ursi* is scarce in the Southern Uplands and Northern Isles. *Loiseleuria procumbens* is a montane species which is scarce in the Northern Isles.

Large-scale Field Indicators

W = Weather-blasted (either due to drying winds, mostly in winter or spring, or summer drought on shallow soils); **I** = Insect damaged (by heather beetle or various moth caterpillars); **F** = Fungal attack (root rots, or “snow mould” damage to foliage and shoots).



Spatial pattern of rusty brown or grey patches in relation to obviously shallow soils.

NB. Old patches of *Polytrichum commune* moss, persisting after heavy burning, can appear rusty brown in the summer when dry.

- On shallow soils immediately around rock outcrops, or over boulders or bedrock near the surface, or on very freely draining soil. ... **W**
- Not obviously related to the occurrence of potentially dry soils. ... **I**
F



Spatial pattern of rusty brown or grey patches in relation to topographic exposure.

NB. Old patches of *Polytrichum* moss persisting after heavy burning can appear rusty brown in the summer when dry.

- On slopes of similar shape and aspect. Affected areas obviously lack shelter from nearby higher ground in the same direction. ... **W**

Damage by insects, fungi and weather

Large-scale Field Indicators

- In relatively sheltered locations or where the dwarf-shrub canopy is taller or has a rougher surface. ... **I**



Spatial pattern of rusty brown or grey patches in relation to altitude.

- Mostly at higher altitudes, > 600 m, or on exposed hill tops or coastal slopes. ... **W**
- Mostly < 600 m altitude. ... **I**
- In distinct altitudinal band, particularly where dwarf-shrub dominance shifts from *Calluna vulgaris* to *Vaccinium myrtillus*. ... **I**



Pattern of occurrence of affected patches over time.

- Appear successively downwind of the prevailing wind direction in late spring/early summer. ... **I**
- Do not appear successively downwind of the prevailing wind direction. ... **W**
F



Size and shape of affected patches.

- Compact, uniform, regular shapes with more or less abrupt boundaries. Sometimes bands or crescents. Usually 10's m² - 100's m². ... **I**
NB. Size of insect damaged areas can be very variable, occasionally 10's to 100's ha.
- Very small patches or "salt & pepper" appearance. Patches sharp-edged. ... **F**
NB. Very occasionally substantial patches of a hectare or more may be affected.
- Boundaries not sharp. ... **W**
NB. Sharp boundaries can sometimes occur if there are sudden changes in soil depth or sharp transitions from sheltered to exposed ground.

Damage by insects, fungi and weather

Small-scale Field Indicators

W = Weather-blasted (either due drying winds, mostly in winter or spring, or summer drought on shallow soils); **I** = Insect herbivory (by heather beetle or various moth caterpillars); **F** = Fungal attack (root rots, or “snow mould” damage to foliage and shoots).



Ragged or “chewed” appearance to individual leaves and shoot tips of *Calluna vulgaris* or *Vaccinium myrtillus* (check with hand lens).

- Completely or partly consumed (Fig. 48). ... **I**
- Foliage and shoots not “chewed”: the shoots end in complete, though dead, buds and foliage (Fig. 49). ... **W**
F



Direct evidence of attacking fungi.

- Thin, black, flattened, horsehair-like strands may be found attached or twined among *Calluna vulgaris* stems. Small, pale brown, parasol-shaped toadstools, about 0.5 cm - 1 cm diameter, may also be found growing from infected stems. (Heather rhizomorph fungus, *Marasmius androsaceus*). ... **F**
NB. Not always very obvious and may not persist.
- Greyish-white weft of threads, like dense cob-webs, over the flattened shoots and foliage of dwarf-shrubs, usually at the edge of melting snow drifts (“Snow mould”). (Fig. 50) ... **F**
NB. Obvious for a few weeks only after snow melts but the matted, flattened state of the shoots is persistent.
- A dark discoloured stain in the wood at the base of affected stems. ... **F**
NB. Not always present.



Degree to which individual stems are affected.

- Completely affected, adjacent to or even touching completely unaffected stems or bushes (check by disentangling stems). ... **F**
- Only parts of stems affected, at least at the edges of the affected patch. ... **W**
I

Damage by insects, fungi and weather

Small-scale Field Indicators



Browning or greying in relation to potential exposure to the wind.

- Highest, most exposed, parts of bushes most severely affected. ... **W**
- Most recent shoot growth, but not necessarily the highest parts of bushes, most severely affected. ... **I**
- Lowest, oldest, parts of bushes most severely affected or whole stem/bush affected. ... **F**



Plant species affected.

- *Erica cinerea* and *Vaccinium myrtillus* perhaps more affected than *Calluna vulgaris*. Low-growing, creeping species such as *Arctostaphylos* spp., *Empetrum nigrum*, and *Loiseleuria procumbens* less affected. ... **W**
NB. If severe conditions occur during the growing season (e.g. drought) then a wider range of species will be affected. Winter browning has little effect on deciduous graminoids which, in summer, helps distinguish it from browsing effects.
- *Erica cinerea* and *Erica tetralix* very little affected or unaffected. *Vaccinium myrtillus* often affected in preference to *Calluna vulgaris*, or affected first. Other species little affected. ... **I**



Spatial pattern of rusty brown or grey bushes.

- Scattered extensively (100's m², or more), in lines or small patches, showing little or no relationship to exposure to the wind: "salt & pepper" effect. ... **F**
NB. In severe cases all the bushes in a patch may be affected and the patch will be uniformly brown or grey.
- Scattered extensively (100's m², or more), or uniform patches, but damage reflecting degree of exposure to wind. ... **W**
- Not extensively scattered, uniform patches of affected bushes. ... **I**

Part 5: Illustrations



1. Sheep scar.



2. Swarm of sheep scars on a heavily grazed slope.



3. Tall herb habitat on rocky, broken ground. There may also be less obvious potential tall herb habitat (in a suppressed state) on nearby ground more accessible to sheep and deer.



4. Heavily browsed juniper in the foreground and midground. Note heavily clipped, rounded shapes.



5. *Polytrichum commune* on intensely burnt peat around the edges of a peat filled basin. The deeper parts of the basin were moister during the fire and were burnt less severely.



6. Extensive bare peat caused by heavy trampling (in this case by red deer).



7. Widespread and abundant flowering of *Eriophorum vaginatum*.



8. Browsed *Calluna* on the left, unbrowsed *Calluna* on the right. Note the greyer colour on the left.



9. Browsed *Calluna* on the left, unbrowsed *Calluna* on the right. Note the greyer colour on the left.



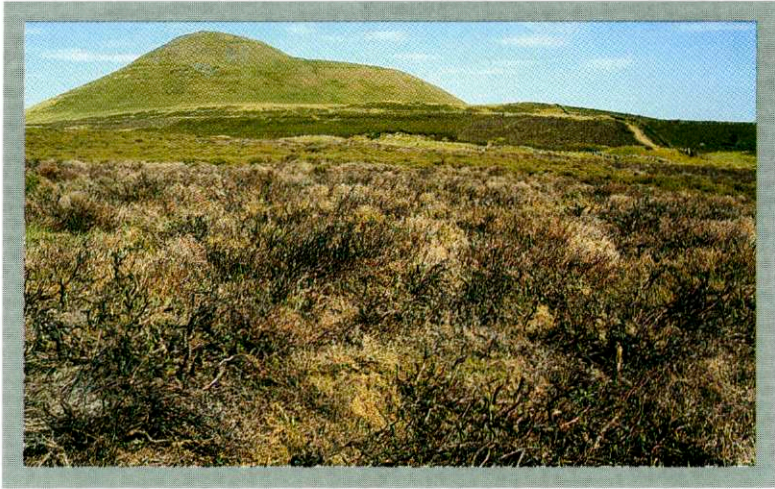
10. Note the different colours of *Calluna* heath on the hill in the background. The central enclosure is very lightly browsed/unbrowsed while on either side of this the *Calluna* is heavily browsed.



11. Narrow zone of heavily browsed *Calluna* heath adjacent to grassland, when browsing is moderately heavy. Note the absence of flower capsules and the change of canopy colour of the *Calluna* close to the grassland.



12. Narrow zone of heavily browsed *Calluna* heath adjacent to grassland., when browsing is moderately heavy. Note the absence of flower capsules and the change of canopy colour of the *Calluna* close to the grassland.



13. Patchy blackening and irregular spread of low intensity fire.



14. Extensive and persistent patches of *Polytrichum commune* established after a very high intensity fire. Brownish patches in the background are also dominated by *Polytrichum commune*. The fire occurred about 20 years before this photograph was taken.



15. Considerable inter-patch variation in dwarf-shrub habitat produced by moderately frequent burning by moderately sized fires. The different colours, tones and textures of the patches are indicative of differences in age since burning, dwarf-shrub dominance and height of the vegetation.



16. Abundant uprooted tufts of *Festuca ovina* tillers in a heavily grazed patch of smooth grassland.



17. Mat of dead plant litter (straw coloured) in lightly grazed smooth grass sward.



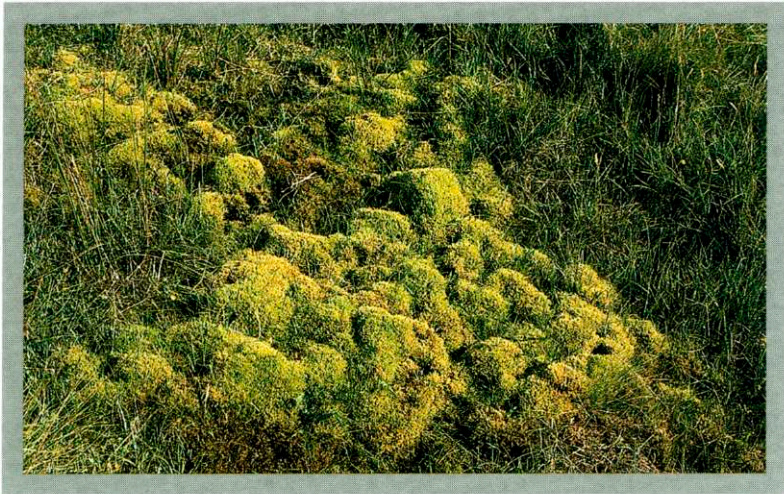
18. Heavily grazed *Dryas octopetala*. Note the moderately grazed area, with some flowering of *Dryas*, in the bottom right part of the photograph.



19. Abundant flowering of herbs in lightly grazed smooth grass sward.



20. High cover of feather mosses (in this case *Rhytidiadelphus squarrosus*) in heavily grazed smooth sward.



21. Moderate degree of disruption of springhead moss mat by grazing and trampling.



22. Leaves of *Trollius europaeus* strongly dwarfed by heavy grazing. These are only 1 - 2 cm across, but note the 5 main leaf lobes and somewhat glossy surface. There are also some dwarfed *Filipendula ulmaria* leaves in the upper part of the photograph.



23. Leaves of *Geum rivale* strongly dwarfed by heavy grazing.



24. Tall herbs vigorously growing and flowering where lightly grazed: *Geranium sylvaticum* in flower on an ungrazed ledge.



25. Tall herbs vigorously growing and flowering where lightly grazed: *Filipendula ulmaria* (and *Luzula sylvatica*) where grazing is very light.



26. Heavily browsed juniper. Most shoots have been clipped.



27. Abundantly revegetating ditch, in this case with *Sphagnum* regrowth, possibly indicative of reduced drainage.



28. Widespread "bleaching" of *Sphagnum*, but damage mostly superficial, under moderate intensity burning.



29. Abundant "bushy" *Cladonia* lichens probably indicative of infrequent burning.



30. Abundant flowering of *Rubus chamaemorus*.



31. *Juncus squarrosus* leaf rosettes become overgrown by surrounding plants (in this case *Sphagnum*) where grazing has been high but has decreased.



32. "Drumstick" growth form of *Calluna* bushes when chronically heavily browsed.



33. “Topiary” growth form of *Calluna* when chronically heavily browsed.



34. “Carpet” growth form of *Calluna* when chronically heavily browsed.



35. Shoots grow densely packed together in the canopy of heavily browsed *Calluna*. This can make it difficult to see beyond the surface of the canopy when standing over the bush (cf. Figs. 37-38).



36. Contorted shoot growth typical of chronically heavily browsed *Calluna*.



37. Very lightly browsed *Calluna* bush. Note open, upright and uncontorted structure.



38. Canopy of a lightly browsed *Calluna* bush from above. Note the relatively open surface which allows one to see quite far into the structure of the bush (cf Fig. 35).



39. Increasing browsing of *Calluna* leading to stripping of upper canopy. Note the rough and ragged appearance of the surface of the canopy.



40. Very extreme stripping away of the surface canopy of *Calluna* where very heavy browsing has been a relatively recent phenomenon (in this case because the area has been used for winter supplementary feeding of livestock).



41. During low intensity fires in dwarf-shrub habitat there is mostly only light charring of stems and much material remains unburnt. In this example the fire has been very light and even much of the fine shoots material has only been singed.



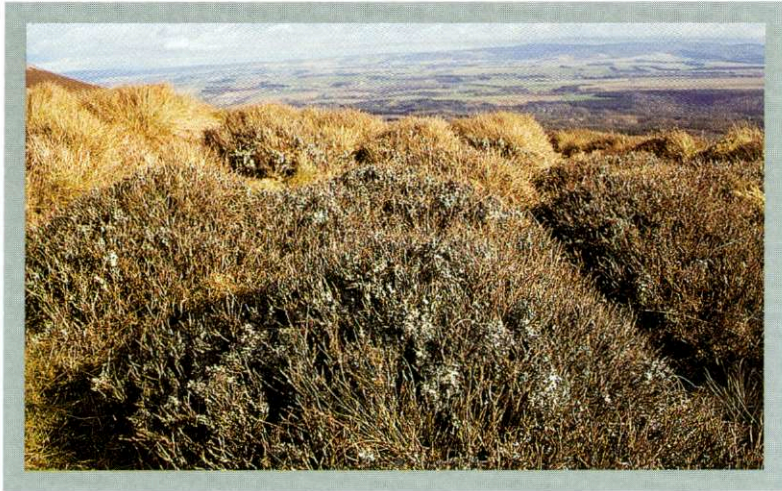
42. Note the amount of unburnt stem material and unburnt plant litter and moss between the stems in this example of a low intensity fire.



43. *Calluna* seedlings regenerating abundantly in a heavily, but not excessively, burnt patch. Regeneration from seedlings may be abundant after moderate to high intensity fires, provided the soil is not consumed, and the soil surface remains consolidated.



44. Parts of *Lycopodium clavatum* plants are likely to survive a moderate intensity fire but not a high intensity fire. Note the surviving and regrowing green shoots arising from positions within the plant litter where they were insulated from the effects of the fire.



45. *Hypogymnia physodes* can sometimes grow abundantly on the stems of dwarf-shrubs where burning has been infrequent (in this case *Vaccinium myrtillus* stems).



46. Grazed *Nardus* tussock: indicative of heavy grazing if it occurs in either tussock grassland or dwarf-shrub heath.



47. Lightly burnt tussock grass. Note that much of the standing leaf material and litter remains unburnt.



48. "Chewed" appearance of *Calluna* leaves and shoots immediately after heavy insect herbivory (in this case by the heather beetle).



49. *Calluna* shoots damaged by severe weather. Note that the leaves are entire and the shoots do not have a “chewed” appearance.



50. “Snow mould” damage to *Calluna*. Note the flattened shoots and the whitish cob-web of the mould.

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