

An assessment and evaluation of herbivore impacts on designated habitats on Foinaven Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC)





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RESEARCH REPORT

Research Report No. 1015

**An assessment and evaluation of herbivore
impacts on designated habitats on Foinaven
Site of Special Scientific Interest (SSSI) and
Special Area of Conservation (SAC)**

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RESEARCH REPORT

Summary

An assessment and evaluation of herbivore impacts on designated habitats on Foinaven Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC)

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Keywords

Foinaven SAC/SSSI; Herbivore Impact Assessment (HIA); wet heath; blanket bog; dry heath; red deer; sheep; grazing; trampling.

Background

This report describes the results of a Herbivore Impact Assessment undertaken on Foinaven SAC/SSSI. The assessment repeated the monitoring of HIA plots across the site undertaken previously in 2010 and 2004 encompassing the SAC features blanket bog, dry heath and wet heath. The current state of herbivore impacts and changes since the previous assessments are described in detail.

Main findings

- Grazing and trampling impacts on wet heath, blanket bog and dry heath were reassessed on Foinaven SAC/SSSI. Fieldwork was carried out in June and July 2015.
- Forty-six 0.25 km² monitoring squares, encompassing 415 individual assessment plots, were assessed using the herbivore impact assessment system developed by MacDonald *et al.* (1998).
- The same squares were assessed in the current survey as in the 2010 and 2004 monitoring cycles (Dayton & O'Hanrahan 2011, Morris 2005). Survey methods replicated those carried out in the 2010 monitoring cycle, allowing direct comparison of the results.
- A comparison of like-for-like data between 2010 and 2015 suggests relatively little change in herbivore impacts has occurred overall.
- Overall, herbivore impacts in 2015 were predominantly Low or Moderate-Low across the site. Over 78% of blanket bog plots, 57% of wet heath plots and 63% of dry heath plots had trampling and grazing impacts in the ranges 'Low' or 'Moderate-Low'.
- Relative to 2010, both blanket bog and dry heath showed similar but decreased trampling and browsing impacts while wet heath showed a slight increase.
- Locally heavy trampling and browsing still occurred in all three habitats but wet heath was the most affected by higher impact values, especially to the north of Arkle between Loch a Garbh-bhaid Mor and Loch an Easain Uaine – an area which also returned higher impact values during previous surveys.

- There appears to have been a notable reduction in herbivore impacts in three areas which gave rise for concern in 2010; namely Coire Grànda - Meall Horn, the western side of Strath Beag and east of Cranstackie.
- Red deer remained the dominant herbivores on the site, though some sheep were present on the northern, eastern and extreme southern parts of the site.
- The prognosis for blanket bog and dry heath habitat condition across much of the site remains generally good. Wet heath has benefited from reductions in herbivore impacts in the north-west of the site, but elsewhere moderate or higher levels of impact may cause the habitat to continue to deteriorate. The main areas where herbivore pressures remain high enough to potentially cause significant deterioration in the quality of habitats – predominantly wet heath – lies to the south-west of the site north of Arkle between Loch a Garbh-bhaid Mor and Loch an Easain Uaine, and the southern and eastern boundaries of the SAC.

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1. INTRODUCTION

1.1 Background

The rationale for the commissioning of a series of Herbivore Impact Assessments (HIA) of the Foinaven SSSI/SAC (the third cycle of which is described in this report) has already been thoroughly described in previous publications, as has the site's general topographical setting together with its ownership and management units (Dayton & O'Hanrahan, 2011; Morris, 2005).

The current assessment was designed to repeat the monitoring of HIA plots across the site, undertaken previously in 2010, and which encompassed three SAC features:

- H4010: Northern Atlantic wet heaths with *Erica tetralix* (called 'Wet heath' in this report)
- H4030: European dry heaths (called 'Dry heath' in this report)
- H7130: Blanket bogs (called 'Blanket bog' in this report)

The main aim was to identify any changes in herbivore impact which might have occurred in the intervening period and any potential trends. The results allowed a direct comparison with the 2010 survey but, as with the previous monitoring exercise (Dayton & O'Hanrahan, 2011), only a more generalised comparison can be made with the baseline 2004 survey due to the different methodology originally used (Morris, 2005).

1.2 Survey logistics

The survey was carried out by Colin Wells, Ruth Maier and Tim Rafferty over a 2.5 week period during mid-June to early July 2015. 48 person-days were required to complete the fieldwork required for this report together with the fieldwork for Site Condition Monitoring on the same site which is reported separately (Wells, 2018).

2. METHODS

2.1 Basic approach and comparison with 2010 herbivore impacts survey

The present survey reassessed sample plots situated within 46 x 0.25 km² (500 x 500 m) monitoring 'squares' spread throughout the site. Within each square, target habitats were assessed at up to five locations. Each assessment plot was separated by a minimum 50 m distance from the nearest neighbouring plot within the square.

In practice, no more than two habitats were assessed in any one square. This resulted in a total of 415 individual sample plots encompassing all three target habitats (comprising 185 wet heath plots, 187 blanket bog plots and 43 dry heath plots).

The same assessment method was used as in the 2010 survey, based on MacDonald *et al.* (1998, 2007) with some amendments and additions (see Dayton & O'Hanrahan, 2011, pp. 4-8).

2.2 Waypoints and field procedure

Waypoint locations from the 2010 monitoring cycle were relocated using hand-held GPS receivers.

Each assessment location comprised a 2 m x 2 m plot, which was marked at the corners (to assist in defining the assessment areas in the plot photographs) and usually aligned north from the recorded grid reference unless topographical considerations made this impractical.

Two photographs were normally taken of each plot, one close-up and one context shot to potentially aid plot relocation. The orientation of the photographs was noted, with most being on a S-N axis.

Notes were sometimes taken of any additional elements of interest at the waypoint where relevant, e.g. deer observations or erosion features.

3. RESULTS - GENERAL

All 46 of the monitoring squares assessed in the two previous assessments and all 415 plots visited in 2010 were reassessed in 2015. The distribution of the sample squares across the site is shown on Map 1; the areas lacking squares are generally dominated by montane habitats such as alpine and boreal heaths, moss-heaths and scree.

Details of all the assessments and impact scores derived from these for each management unit are given in Annex 1 (archived electronically) in the form of Microsoft Excel spreadsheets.

3.1 Habitat Impacts – overall

The results are described in detail in the following sections, initially in terms of the three individual habitats, followed by a more limited treatment of the results on a management unit basis (as the original survey design did not take this explicitly into account).

In addition to the generalised herbivore impacts indicated by the averaged square results, (which allow a broad overview 'at a glance'), the data are also presented from each individual plot monitored, thus allowing a more finely resolved picture of impacts to be discerned.

3.2 Habitat Impacts – wet heath

3.2.1 Trampling

(Maps 2, 3, Annex 2)

The majority of wet heath plots returned Low or Moderate-Low trampling impacts, with 60% lying in this category. Nearly a quarter (23%) returned Moderate impacts while 15% indicated High-Moderate impacts and 2% High (Figure 1).

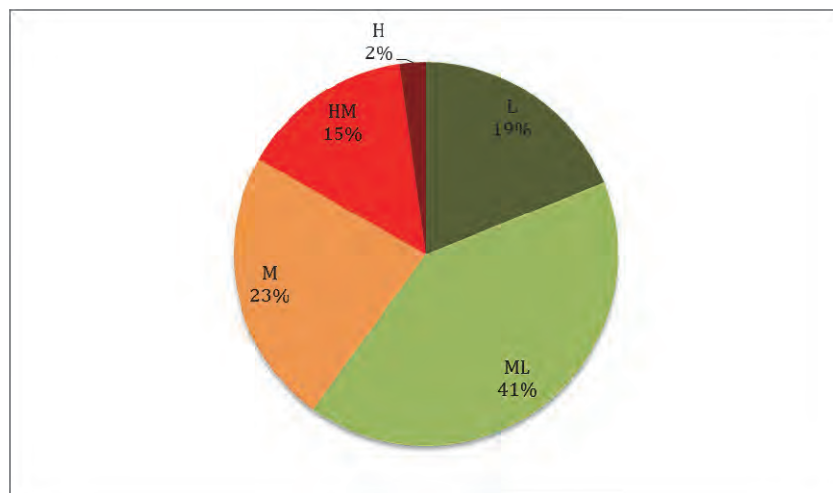


Figure 1. Wet heath trampling by plot n=185

The greatest concentration of higher trampling impacts lay towards the south-west of the site, located at pinch points where deer routes converge, such as at the junction of Loch nam Blàr-loch, Am Bàthaich, Loch an Easain Uaine and Creag nam Blàr-loch (Maps, 2,3).

3.2.2 Browsing

Browsing impacts closely followed those from trampling, with the majority (57%) returning Low or Moderate-Low values, 27% Moderate, 11% High-Moderate and 5% High impact values (Figure 2).

Distribution of the highest browsing impacts reflected those for trampling closely, apart from a browsing 'hotspot' in the north-east of the site on the SAC boundary in Strath Beag (Maps, 4,5).

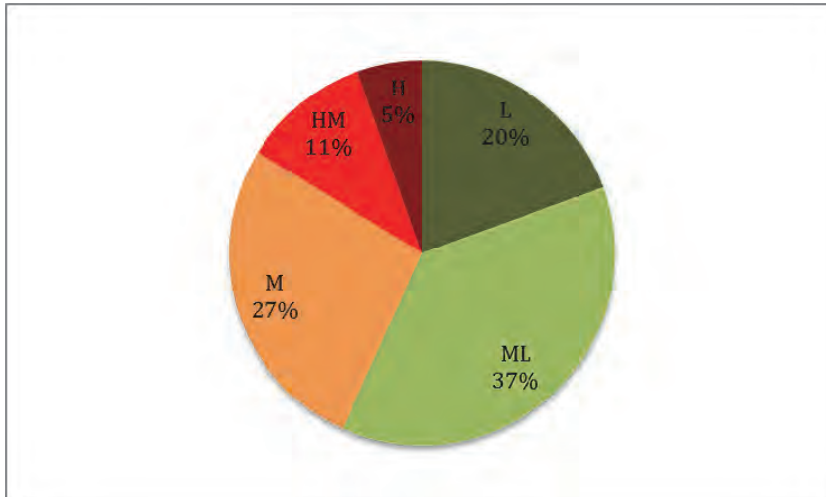


Figure 2. Wet heath browsing by plot n=185

3.2.3 Dung

Dung concentrations were predominantly in the High-Moderate category across the south and central areas of the site and predominantly Low across the north, west and eastern parts (Map 6).

3.2.4 Trend indicators

Of the wet heath squares returning discernible long-term indicator trends, all except two registered either Chronic Low or Chronic Low-Chronic Moderate trends for herbivore impacts. Two Chronic Moderate squares were recorded (Map 7).

Where recorded, Trend direction data was inconclusive, suggesting a nearly even split in wet heath squares where results were recorded between signs of increasing impacts and declining impacts (Map 8).

3.3 Habitat Impacts – blanket bog

3.3.1 Trampling

Of the 187 blanket bog plots assessed for the whole site, over four-fifths, 82%, were either in the Low or Moderate to Low overall trampling impact class. 15%, were in the Moderate impact class, 3%, in the High-Moderate impact class and just one plot (<1%) in the High impact class for trampling (Figure 3).

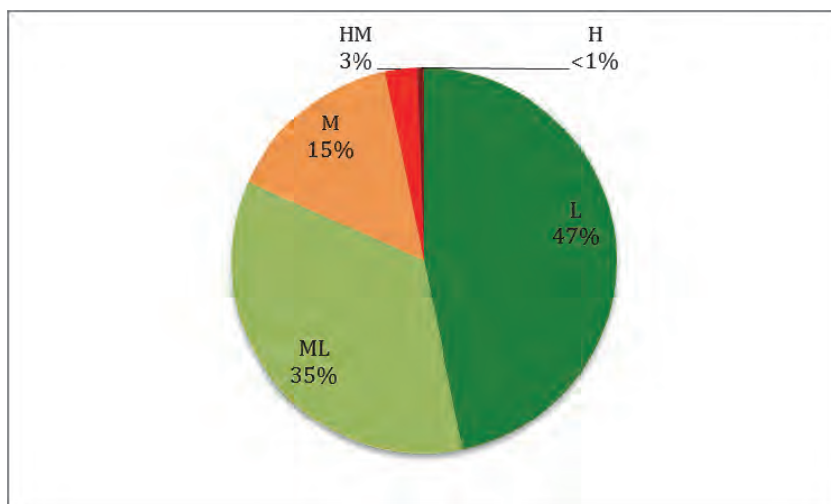


Figure 3. Blanket bog trampling by plot n=187

The small number of plots returning Moderate to High trampling impact scores were scattered in clusters around the site, most notably at the southern end of Strath Dionard, and at the south-western boundary of the site (Maps 9, 10).

3.3.2 Browsing

Browsing on blanket bog showed a broadly similar story to trampling, with 78% of all plots having overall scores in the Low or Moderate to Low impact classes, 16% with a Moderate overall impact class, 5% with High-Moderate impacts and 1% in the High impacts category (Figure 4).

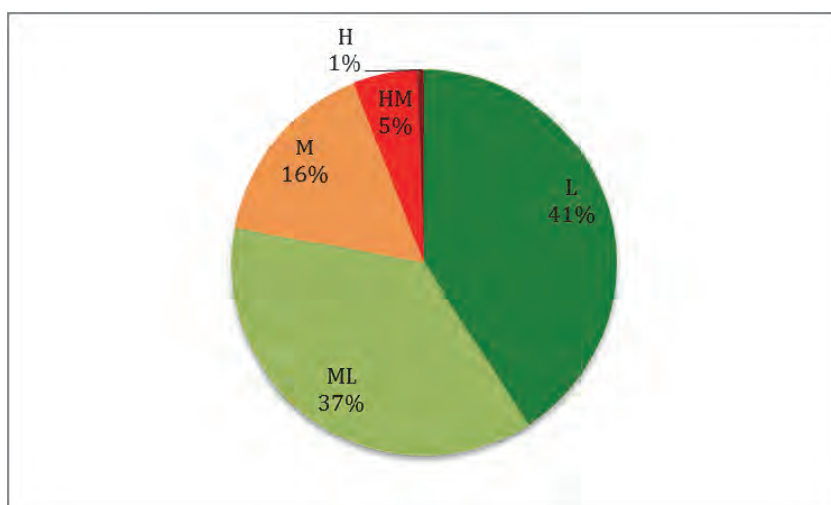


Figure 4. Blanket bog browsing by plot n=187

The plot with the highest browsing impact class lay in the north-central section of Reay near to Plat Reidh. Other higher than average browsing hotspots included the south-western boundary of the site and just north of Loch nam Blar-loch (Maps, 11, 12).

3.3.3 *Dung*

Only a small number of the squares assessed for blanket bog had High-Moderate scores for dung pellet density – one in the far south, one in Strath Dionard and one on the east of the site. The remainder returned values in the low-moderate range (Map 13).

3.3.4 *Trend indicators*

Where recorded, trend indicators show the great majority of blanket bog squares to be subject to Chronic Low or Chronic Low- Chronic Moderate impacts. Chronic Moderate and the single Chronic Moderate-Chronic High squares are mostly located in the east-central part of the site (Map 14).

Only a few squares returned discernible trend direction results. Most of these few suggested increases in impacts.

3.4 Habitat Impacts – dry heath

3.4.1 Trampling

63% of the dry heath plots returned Moderate-Low impacts for trampling, 23% Moderate, 12% High-moderate and 2% High (Figure 5). The highest impacts were localised and present between Loch nam Blar-loch and Loch an Easain Uaine and in the east of the site (Maps 16, 17).

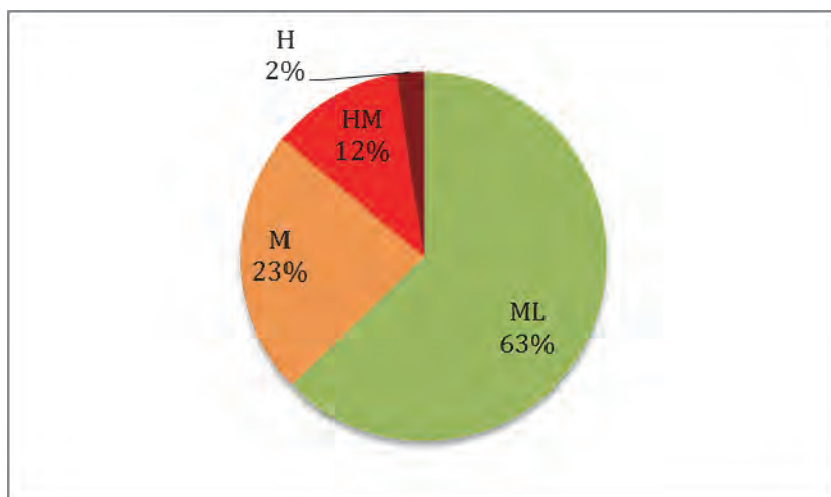


Figure 5. Dry heath trampling by plot n=43

3.4.2 Browsing

Browsing of dry heath closely mirrored trampling returns, with 12% in the Low category, 63% Moderate-Low, 18% Moderate and 7% in the High-moderate category (Figure 6). Distribution of impact classes also strongly corresponded with those for trampling (Maps 18, 19).

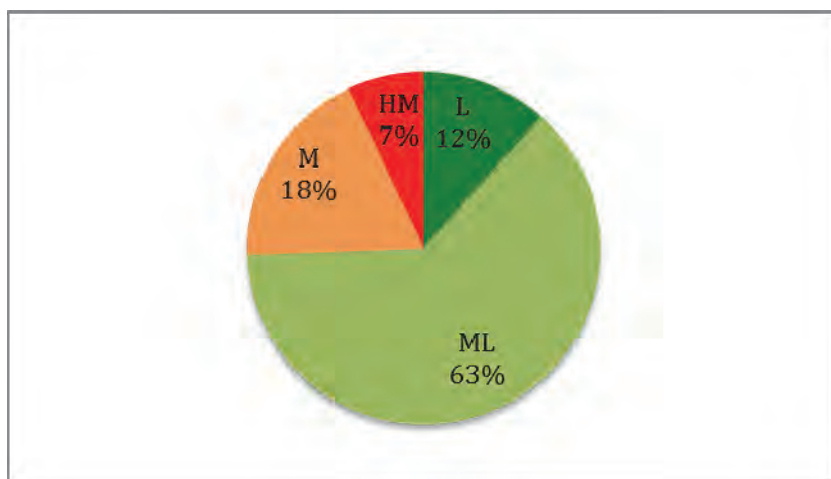


Figure 6. Dry heath browsing by plot n=43

3.4.3 Dung

The highest dung concentrations were to be found to the east of the site. Elsewhere, levels were mostly Moderate to Low (Map 20).

3.4.4 *Trend indicators*

All dry heath squares that returned trend indicator values recorded either Chronic Low-Chronic Moderate or Chronic Moderate returns (Map 21). The five squares that gave possible indications of trend direction returned mostly suggestions of increasing impacts (Map 22).

3.5 Herbivores

The current survey was not designed to estimate the number of grazing animals present, focusing instead on the impacts of animals on vegetation. Hence the following notes are based merely on incidental observations made by the survey team as we travelled to monitoring plots across the site.

Red deer clearly remain by far the most significant herbivores on the Foinaven SAC/SSSI, although sheep remain important on Rhigolter Farm (previously known as Balnakeil Estate) in the north and around a dozen were noted within Eriboll with isolated stragglers occurring in eastern and southern Reay and northern Strath Dionard.

Few signs of sheep impacts were recognised from any of the plots visited for this survey apart however, from on the eastern fringes of the site.

Deer sightings were all confined to the outer fringes of the site with regular, but usually small (i.e. rarely >10) groups being observed, mainly comprising hinds and calves. Dung pellet densities however, were widespread in moderate amounts throughout the site, apart from the north-west sector, where they were uniformly low or even absent over large stretches of terrain.

Grouse droppings were frequently encountered – and ptarmigan droppings in the southern Foinaven-Meall Horn area - but neither were observed to be present in significant densities.

4. RESULTS – COMPARISON WITH 2010 RESULTS

4.1 Blanket bog

4.1.1 Trampling

Across the site as a whole, there appears to have been a shift towards lower trampling impacts on blanket bog, with a reduction in the higher impact categories (Figure 7).

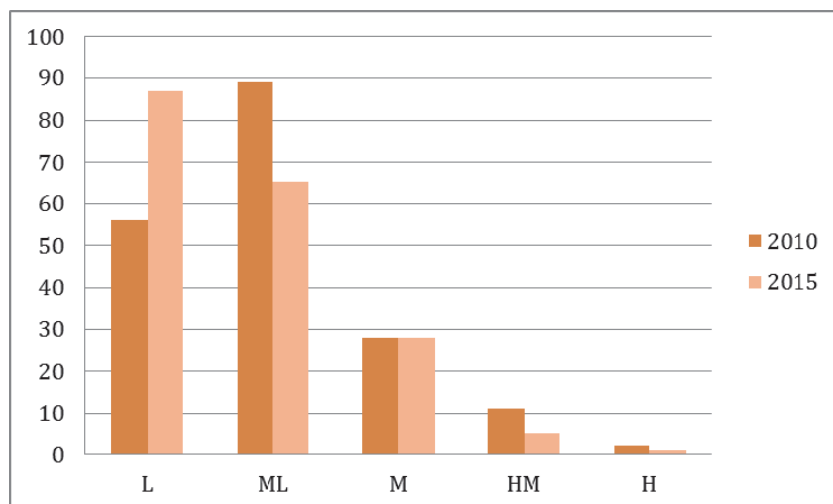


Figure 7. Blanket bog trampling change 2010-2015. X-axis: impact category, Y-axis: Number of plots

Distribution of the changes shows shifts to lower blanket bog trampling impacts are concentrated in the western and southern sectors of the site, whereas the north-central section, focused on Strath Dionard and the far eastern part of Reay are dominated by plots indicating no change, or increased trampling impacts (Map 23).

4.1.2 Browsing

The results for blanket bog browsing closely mirror those for trampling, indicating a slight shift towards lower trampling impacts across the site (Figure 8).

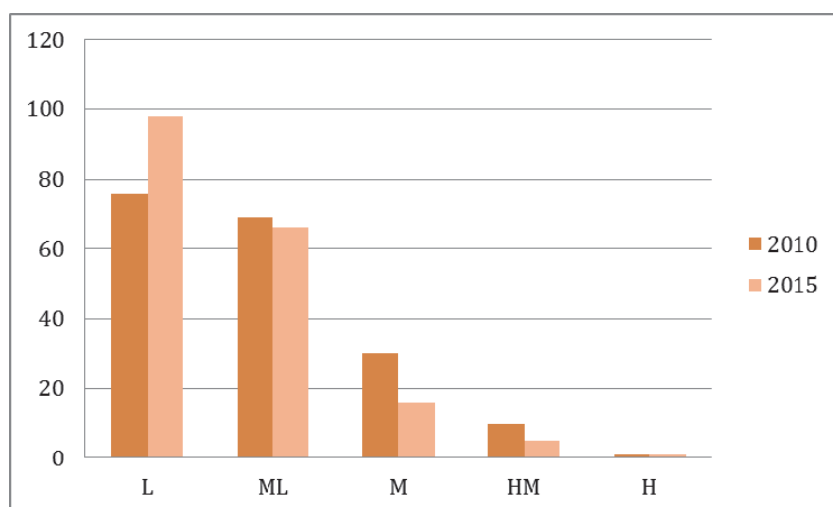


Figure 8. Blanket bog browsing change 2010-2015. X-axis: impact category, Y-axis: Number of plots.

Distribution of the changes again shows shifts to lower impacts are concentrated in the western and southern sectors of the site. Strath Dionard has a cluster of plots characterised no change or increase in impacts concentrated in the northern part of the strath and there is also a focus of increased browsing on the southern borders of the site (Map 24).

4.1.3 Dung

Distribution of dung count changes on blanket bog suggest overall very little difference from 2010 apart from some slight decreases in the central part of the site (Map 25).

4.2 Wet heath

4.2.1 Trampling

Across the site as a whole, there appears to have been a slight shift towards higher trampling impacts on wet heath (Figure 9).

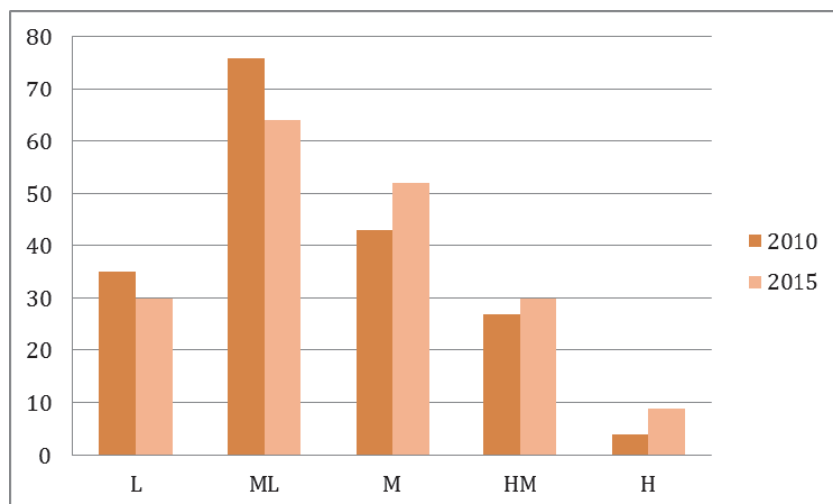


Figure 9. Wet heath trampling change 2010-2015. X-axis: impact category, Y-axis: Number of plots

Distribution of the changes indicates increased impacts (albeit not signifying major shifts of magnitude) are widespread on the habitat across the site although it should be noted that there are also notable clusters of reduced impacts in the extreme west of the site on Rhiconich, on the Rhiconich/Gualin border, in the southern end of Strath Dionard and in Polla (Map 26).

4.2.2 Browsing

The results for browsing on wet heath show a small shift towards higher impacts (Figure 10).

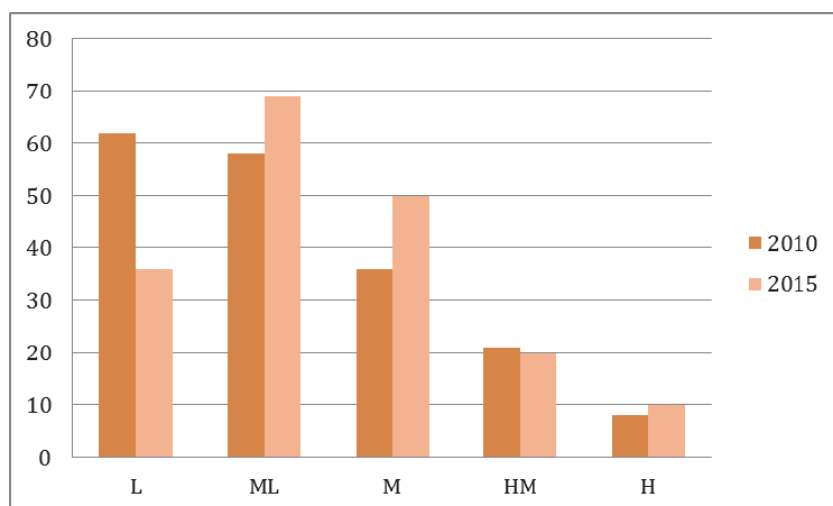


Figure 10. Wet heath browsing change 2010-2015. X-axis: impact category, Y-axis: Number of plots

Distribution of the changes indicates increased browsing impacts are concentrated on the extreme southern boundary of the site in Reay and in the north-western sector of Reay and the south-western part of Rhiconich, and the northern part of Strath Dionard. Reduced impacts are notably clustered in Polla, much of Rhiconich, the Rhiconich/Gualin border, and in eastern and central Reay (Map 27).

4.2.3 *Dung*

Distribution of the changes in dung counts show that most increases are focused on the southern boundary of the site and the southern end of Strath Dionard. Elsewhere, there is relatively little change (Map 28).

4.3 Dry heath

4.3.1 Trampling

Across the site as a whole, there appears to have been very little change in trampling impacts on dry heath, with overall results from the two survey years being similar (Figure 11).

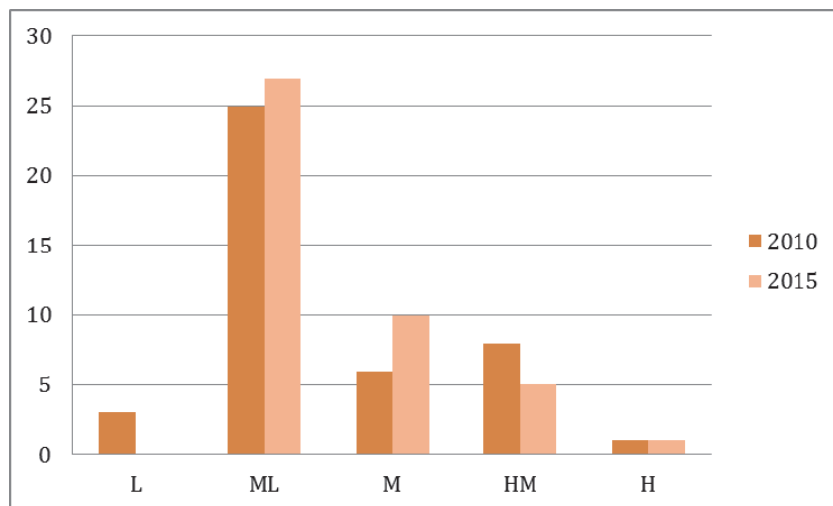


Figure 11. Dry heath trampling change 2010-2015. X-axis: impact category, Y-axis: Number of plots

Distribution of the changes suggests a small increase in trampling impacts in Polla but little overall change elsewhere (Map 29).

4.3.2 Browsing

The dry heath browsing results also point to relatively little change between the two datasets apart from a slight shift towards increased impacts (Figure 12, Map 30).

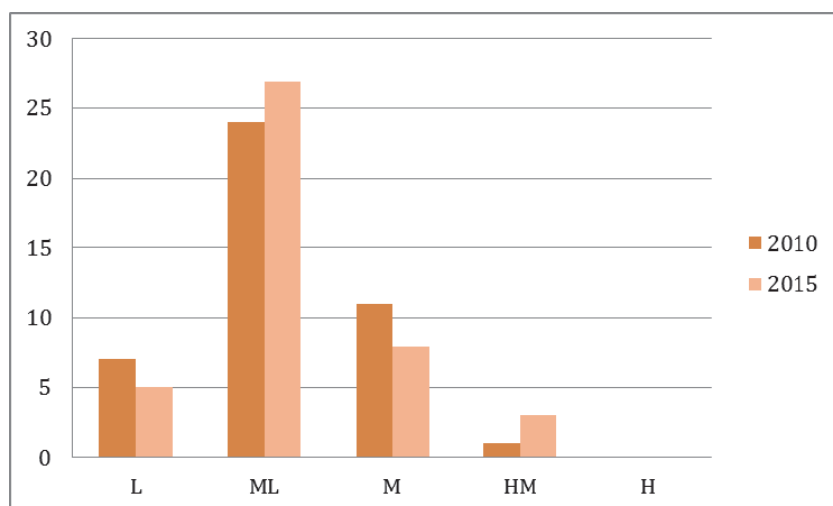


Figure 12. Dry heath browsing change 2010-2015. X-axis: impact category, Y-axis: Number of plots

Distribution of the changes shows little discernible pattern, apart from a minor cluster of increased browsing impacts around Loch Nam Blar-loch in central Reay and concentrations of reductions on the Reay/Rhiconich border and in Polla (Map 30).

4.3.3 *Dung*

Distribution of changes in dung counts on dry heath suggest increases concentrated in the eastern part of the site with relatively little change elsewhere (Map 31).

5. RESULTS – MANAGEMENT UNITS

The monitoring square distribution was designed in the original 2004 study to represent random selections of appropriate habitats throughout the site. Sampling sites were generated using available land cover data - as a result the six landownership units are not uniformly represented due to their relative areas within the designation and the relative proportion of the three target habitats present within each management unit.

The survey was divided between the various landownership boundaries as follows:

Eriboll	1 square
Rhigolter Farm (previously known as Balnakeil Estate)	1 square
Polla (previously known as Rispond and Polla)	3 squares
Rhiconich	8 squares
Gualin	9 squares
Reay Forest	24 squares

5.1 Gualin

Impacts were generally recorded as being relatively low on Gualin, although there are indications of a slight increase in browsing trampling and dunging on wet heath habitats since the last assessment.

5.2 Rhiconich

Browsing and grazing impacts were low over nearly all of this management unit and there were indications of reductions in impacts across the survey area since 2010. A notable reduction has occurred in Square 16 just south of Rhiconich itself, which was noted as receiving localised Moderate to High impacts during the last assessment. The only area with localised higher impacts occurs on the southern Reay boundary (parts of Squares 17 and 20), where some wet heath plots bucked the trend of recording generally low herbivore pressure.

5.3 Polla (previously known as Rispond and Polla)

Generally Moderate to Low impacts were recorded in the three monitoring squares situated within this management unit. This signifies a notable reduction in herbivore pressures since 2010 when Moderate to High pressures were noted. Then, monitoring Square 8 had the highest impact recorded for any habitat on the site, but this has notably reduced to more moderate impact levels.

5.4 Reay Forest

Blanket bog within this management unit was generally subject to Moderate or Low trampling and browsing apart from a few localised 'hotspots' such as within Monitoring Squares 31, 34 and 41. In 2010 the monitoring square with the highest level of trampling of all of the management units for blanket bog was situated in Coire Grànda. This area, encompassed by Square 42, has shown marked reduction in herbivore impacts.

Wet heath showed markedly higher impacts than blanket bog however, especially around the margins of the management unit and especially the west-central 'corridor' stretching from Loch a' Garbh-bhaid Mor to Loch an Easain Uaine. This largely reflected a similar picture of impacts distribution to that of 2010. The returns suggested a slight increase in herbivore impacts in this area however.

As in 2010, Dry heath on the Bealach Horn-Loch nam Blàr-loch-Pollan Dhughail axis showed some Moderate impact scores for trampling, though browsing impacts were generally lower and there was little change to report.

5.5 Rhigolter Farm (previously known as Balnakeil Estate)

The single square on Rhigolter Farm – (No. 2) had Low impact levels on wet heath and blanket bog apart from having a Low to Moderate impact for browsing on blanket bog. There were indications of a slight increase in browsing in wet heath.

5.6 Eriboll

The single square on Eriboll – No. 23, had Low to Moderate overall impact classes for both browsing and trampling on both wet heath and dry heath and there was little change from 2010.

6. DISCUSSION

6.1 Comparison with previous surveys

The previous report (Dayton & O'Hanrahan, 2011) found that some of the areas identified as having relatively high trampling impacts mirrored those from the original 2004 survey (Morris, 2005). These areas included Coire Grànda, the eastern end of Strath Lùib na Seilich and the area between Loch nam Blàr-loch and Loch an Easain Uaine.

The current assessment found that comparatively high trampling impacts – especially on wet heath – remained on the Loch nam Blàr-loch - Loch an Easain Uaine areas and might possibly have increased in intensity. Similarly, wet heath in eastern Strath Lùib na Seilich was still receiving moderate-high impacts from trampling and there were indications that the intensity may have also increased there since the last assessment.

However, impacts in Coire Grànda were found to have been markedly reduced to moderate levels. This is suggestive of a longer-term trend in relaxation of pressures. The previous survey report also suggested that a reduction in impacts may have occurred compared with 2004 (Dayton & O'Hanrahan, 2011).

The 2011 report also raised concerns that impact levels had gone up significantly on the eastern slopes of Cranstackie. With the exception of some evidence for a slight increase in trampling of dry heath from a few individual plots in this area, most indicators during the current assessment suggest that there has now been a lowering of pressures in this area in terms of both trampling and browsing.

Overall, the pattern for browsing and trampling impacts was broadly similar between the 2015 and 2010 surveys with generally moderate or low impacts being most common across the site.

6.2 Future habitat trends

As noted in the previous assessment report (Dayton & O'Hanrahan, 2011, pp. 6-7), 'trend indicators' (*sensu* Macdonald *et al.*, 1998, pp. 21-22) were frequently inapplicable to specific survey plots and also sometimes led to contradictory results within a plot leading to no obvious overall signal.

Because of this the trend results are fragmentary and provide only a very broad-brush indication of impact trends. Overall the data available suggest that most habitats display Chronic Low or Chronic Low-Chronic Moderate trends with outlying clusters of Chronic Moderate-Chronic High trends in the central south-east part of the site (Maps 7, 8, 14, 15, 21, 22).

However, the overall impact results from the current study now provide the information to enable a direct comparison of data between 2010 and 2015. A more accurate 'trend signal' is therefore perhaps more reliably gauged from the changes recorded when 2010 and 2015 data are compared (see the graphs in Section 4). This information arguably supersedes the more subjective 'trend indicator' data, which was originally designed as a rapid means of characterising land management impacts across large tracts of the uplands, and is arguably most useful when used as an initial general pointer when undertaking early assessments of sites in the absence of extensive impact datasets. The discussion below is therefore based largely on the changes in comparative impact data between 2010 and 2015 rather than the Macdonald 'trend indicator' results.

6.2.1 Overview

Overall, the picture from all strands of trends data suggests herbivore impacts are mostly stable over large areas of the SAC with substantial areas showing evidence of having experienced long-term moderate or low herbivore pressures. The exceptions lie mostly towards the south-west of the site, and tend to be clustered around Loch a' Garbh-bhaid Mor to Loch an Easain Uaine and principally concern wet heath.

6.2.2 Wet heath

Wet heath has been subject to slight increases in browsing and trampling across wide areas of the central, southern and western sections of the site, with a notable concentration of higher impacts running in an arc from Cnoc Liath through to the east of Loch a Garbh-bhaid Mor to Loch nam Blàr-loch (Maps 26, 27).

Browsing and trampling levels also seem to have increased through most of Strath Dionard and on the southern boundary of the site.

If these increases are sustained, it is probable that localised deterioration in wet heath habitats will occur in these areas, with potential reduction in cover, depth and diversity of bryophytes and promotion of micro-erosion (Macdonald *et al.*, 1998, pp 164-166).

Elsewhere however, there has been relatively little change since 2010 with impacts remaining mostly moderate long the southern and eastern boundaries of the site. Two areas, in the north-west and north-east of the site, recorded notable reductions in herbivore impacts.

Overall therefore, the prognosis appears to be mixed for this habitat. Given the continuation of current impacts wet heath is likely to remain in a stable or improving condition over some parts of the SAC, especially to the north-west, but further deterioration in habitat quality is probable in the other areas noted above.

6.2.3 Blanket bog

Most areas of the site show reductions in trampling and browsing on blanket bog or little change from lower impact values recorded in 2010. The main exception lies around Strath Dionard where browsing pressures have increased in the far northern section (possibly due to an increase in sheep grazing on Rhigolter Farm) and trampling has shown slight increases more generally across the strath. There also appears to have been an increase in browsing on Plat Reidh (Maps 23, 24). In such areas potential reduction in cover, depth and diversity of bryophytes and promotion of micro-erosion may continue to occur.

Overall however, with the exception of these areas where deterioration of the habitat might be expected, the prognosis for blanket bog over much of the site appears good, with stable conditions or continuing improvement occurring.

6.2.4 Dry heath

Dry heath was mostly found not to be subject to significant impacts over most of its sampled distribution. Nevertheless a few very localised 'hotspots' of higher trampling and browsing were present.

The most conspicuous trampling impacts were noted between Loch nam Blar-loch and Loch an Easain Uaine and a couple of plots towards the eastern part of the site (Maps 17, 19).

In addition, it was noted that in some areas not covered by survey squares trampling impacts were sometimes heavy, especially in sensitive H21 Oceanic heath habitat on steep north-facing slopes, such as below the cliffs south and east of Loch Dionard and the north slopes of Cnoc Duail.

In such heavily-impacted zones, severe disruption of the heather cover of the habitat is likely to continue, with potential loss of conservationally-valuable bryophyte species.

7. CONCLUSIONS

Viewed synoptically, comparatively little change has occurred since the previous assessment in 2010. Most overall impact results were in the Low or Low-to-Moderate classes. There appears to have been a notable reduction in herbivore impacts in three areas which gave rise for concern in 2010; namely Coire Grànda - Meall Horn, the western side of Strath Beag and east of Cranstackie.

High impact levels thus remain unusual on the site, but are locally concentrated. The northern side of Arkle from Loch a' Garbh-bhaid Mor to Loch an Easain Uaine is the main area – mainly affecting wet heath. This continues to be part of a more diffuse, extended zone with locally higher impacts stretching into the south-western marches of Rhiconich.

Moderate impacts on wet heath are prevalent along the southern and eastern marches of the site, and are likely to promote a slow deterioration in habitat condition with potential loss of bryophyte cover.

The far north-west of the site however generally displayed lower impacts than previously - and some areas recorded negligible impacts, such as plots close to Rhiconich. Strath Dionard generally recorded low or moderate impacts but there were indications of higher levels of trampling and browsing on wet heath since the previous assessment.

As was the case in 2010, blanket bog was found to be subject to the lowest impacts of the three habitats. Wet heath continued to show more variation with trampling damage being relatively widespread on this habitat. This may in part be explained by the fact that the majority of the wet heath on this northern site conforms to the M15c sub-community – characterised by usually very thin peaty soils often dominated by a fragile bryophyte and lichen cover. This kind of heath surface is easily broken and disrupted by hooves – or boots – especially when it is saturated, as is often the case.

Dry heath was mostly also found mostly not to be subject to significant impacts, with just a few localised 'hotspots' where impacts were found to be high. However, as noted in the previous survey, it is possible that the results may be under-reporting impacts due to the more restricted distribution of this vegetation and the relatively low number of monitoring squares containing it.

8. REFERENCES

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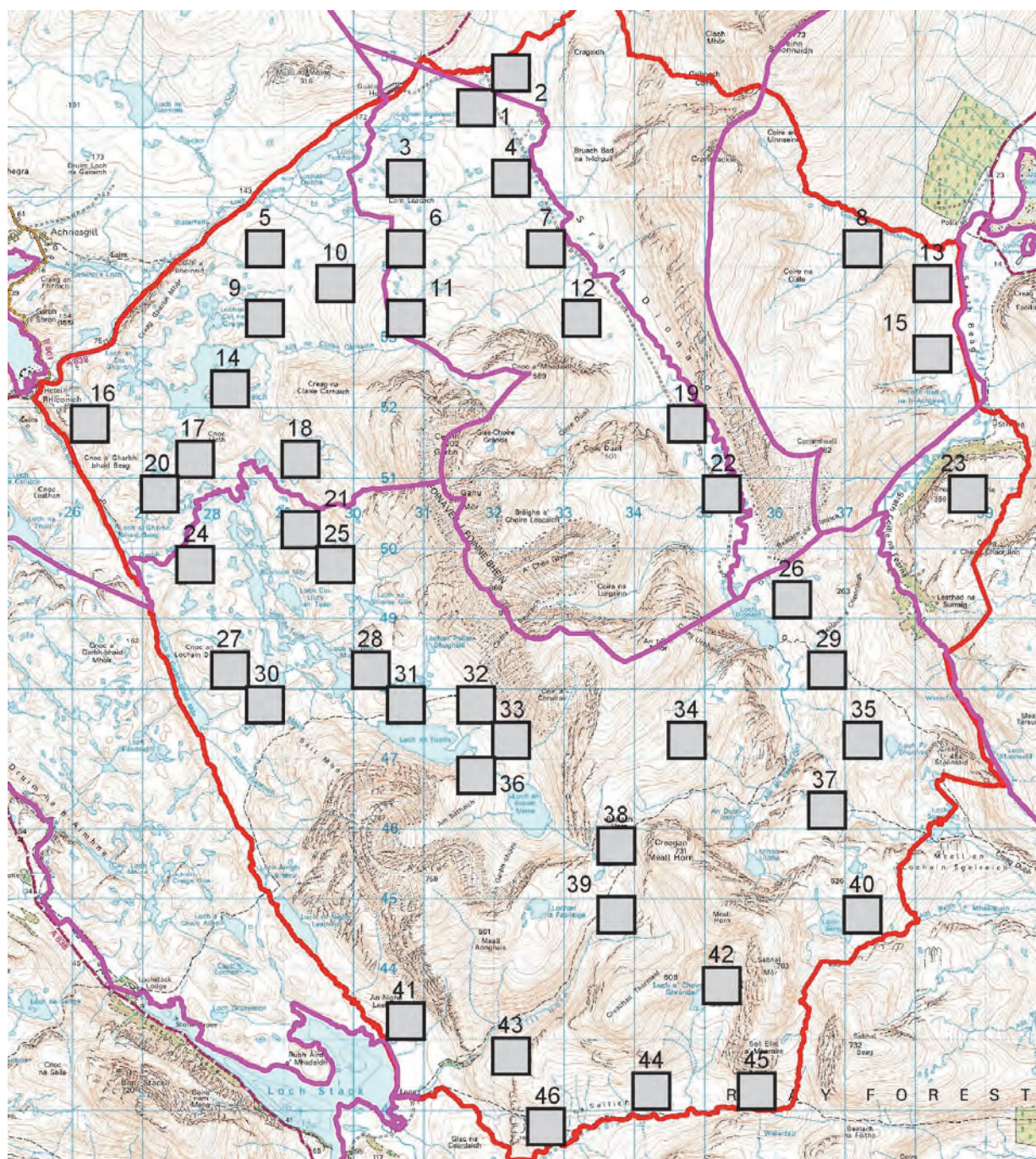
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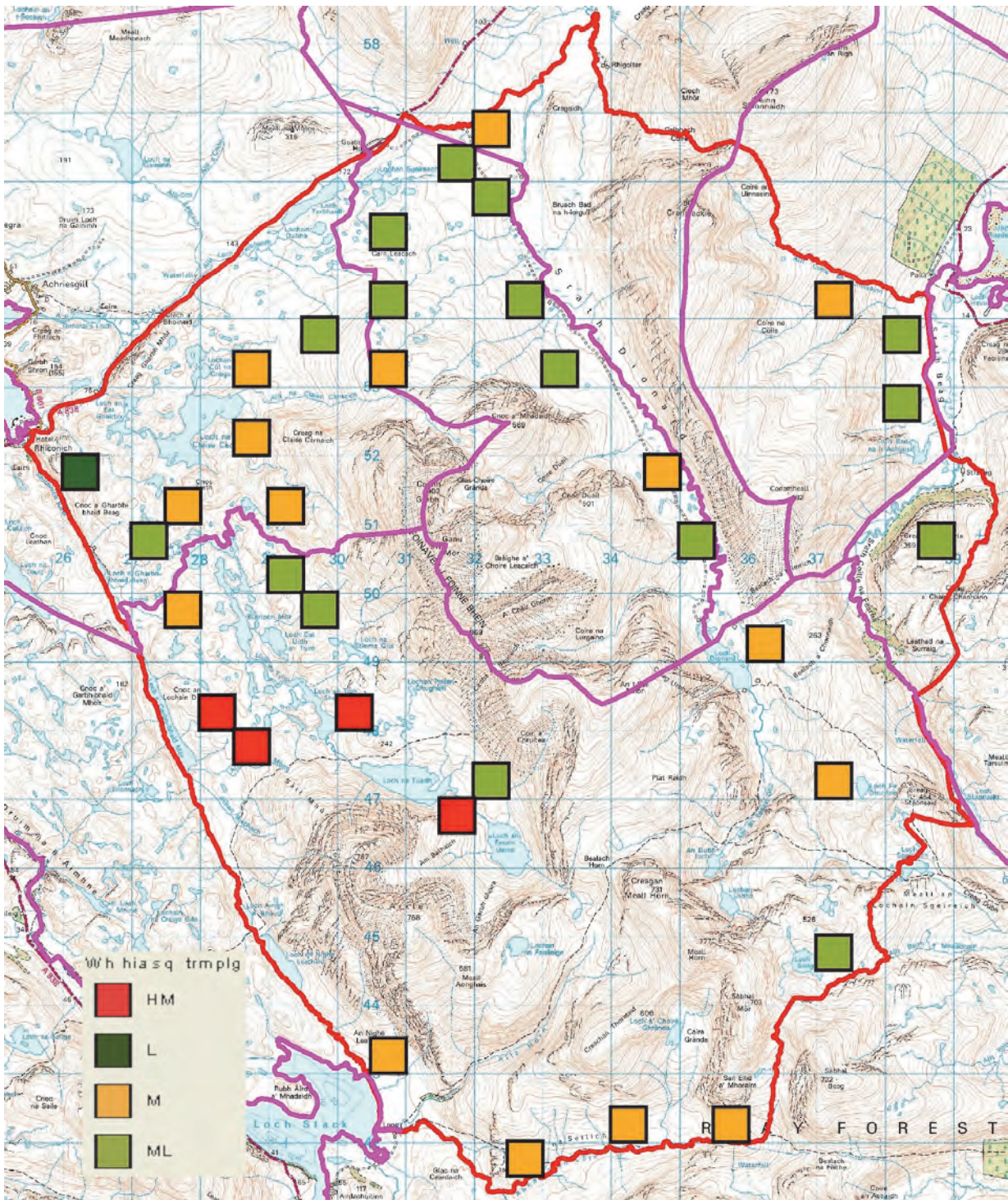
ANNEX 1: SPREADSHEETS

This annex can be downloaded from the SNH website as a separate file.

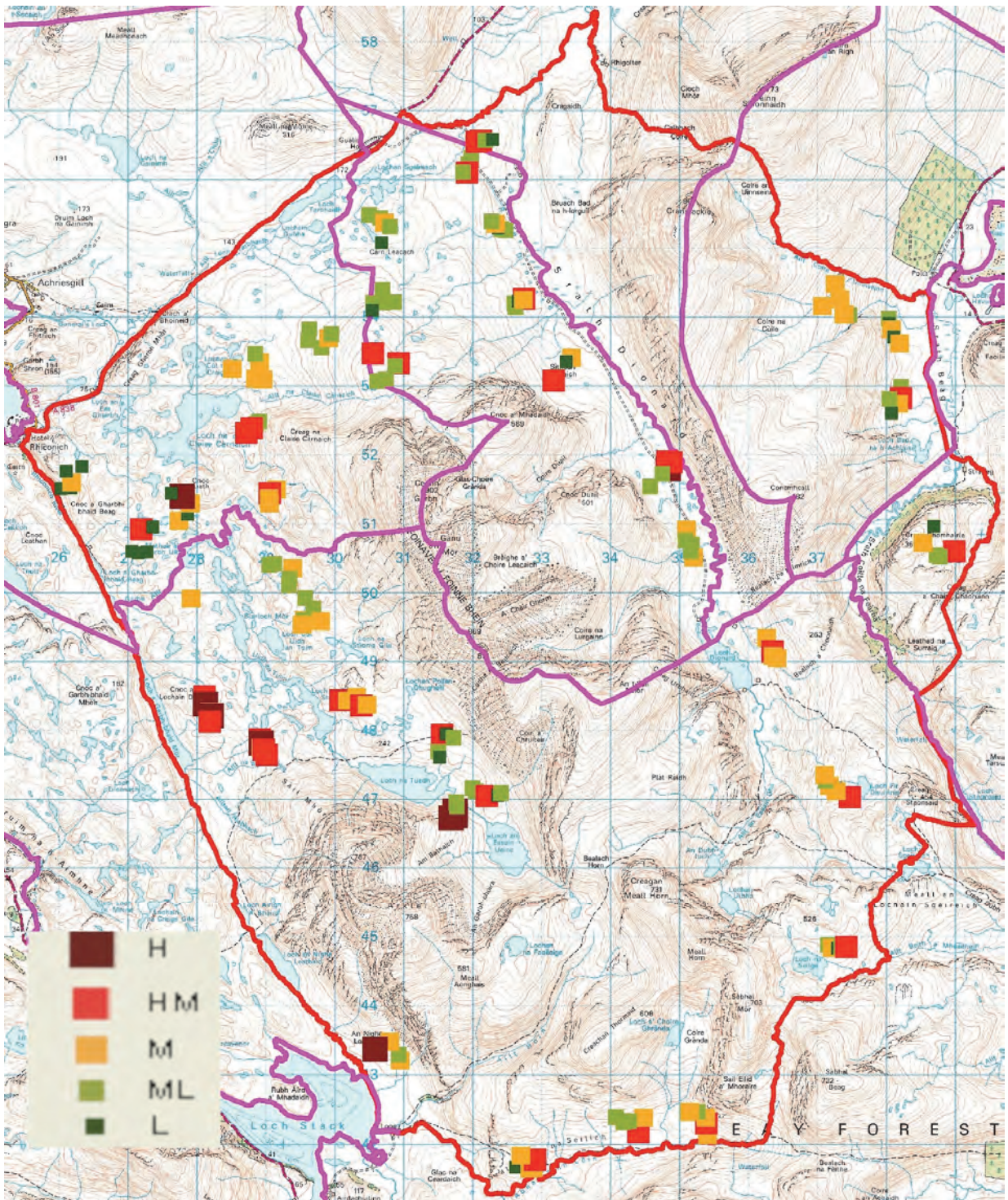
ANNEX 2: MAPS



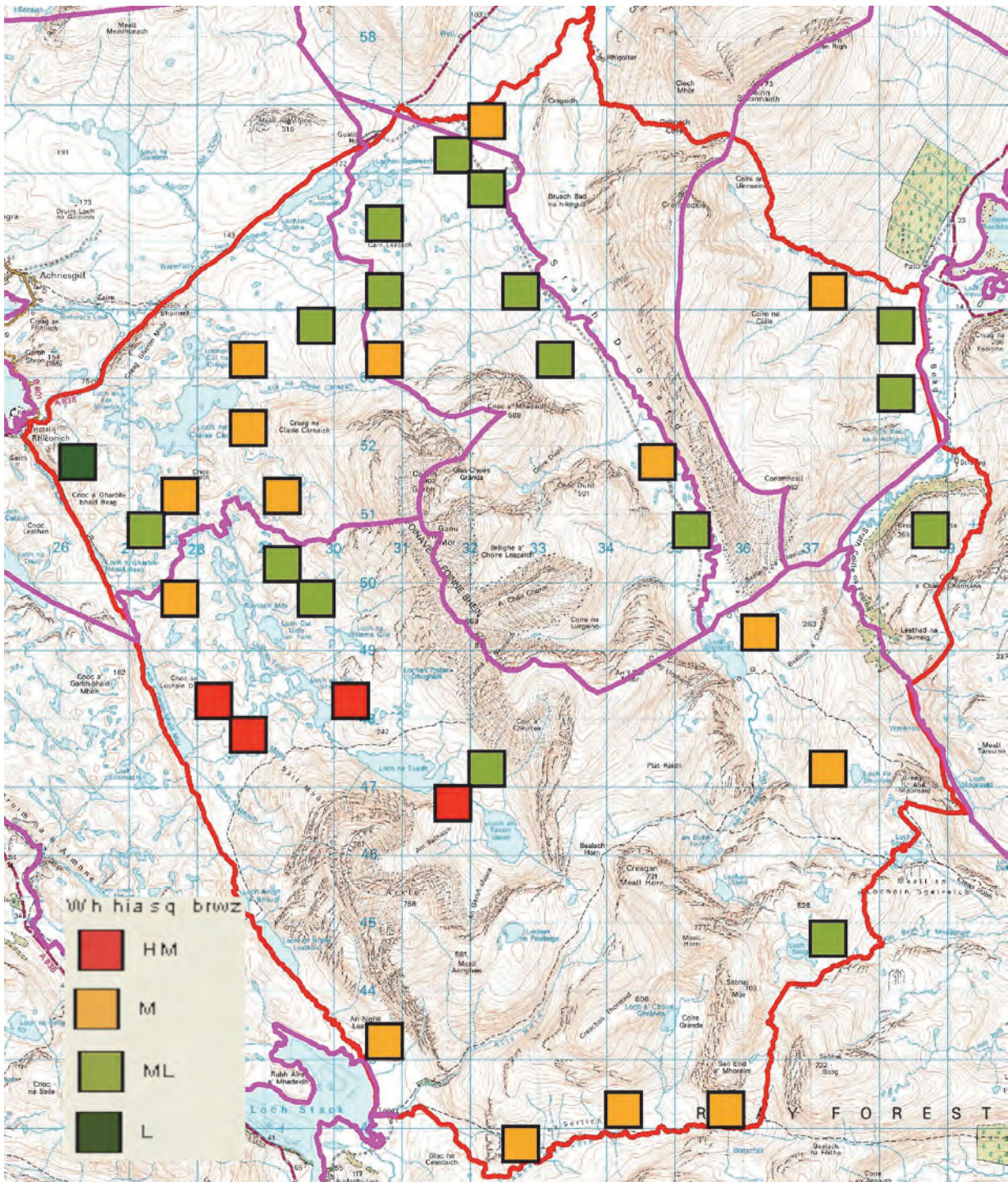
Map 1. Distribution of monitoring squares. The red line shows the boundary of Foinaven SSSI. Foinaven SAC is slightly smaller in Strath Beag in the northeast of the site. The pink lines show ownership boundaries. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



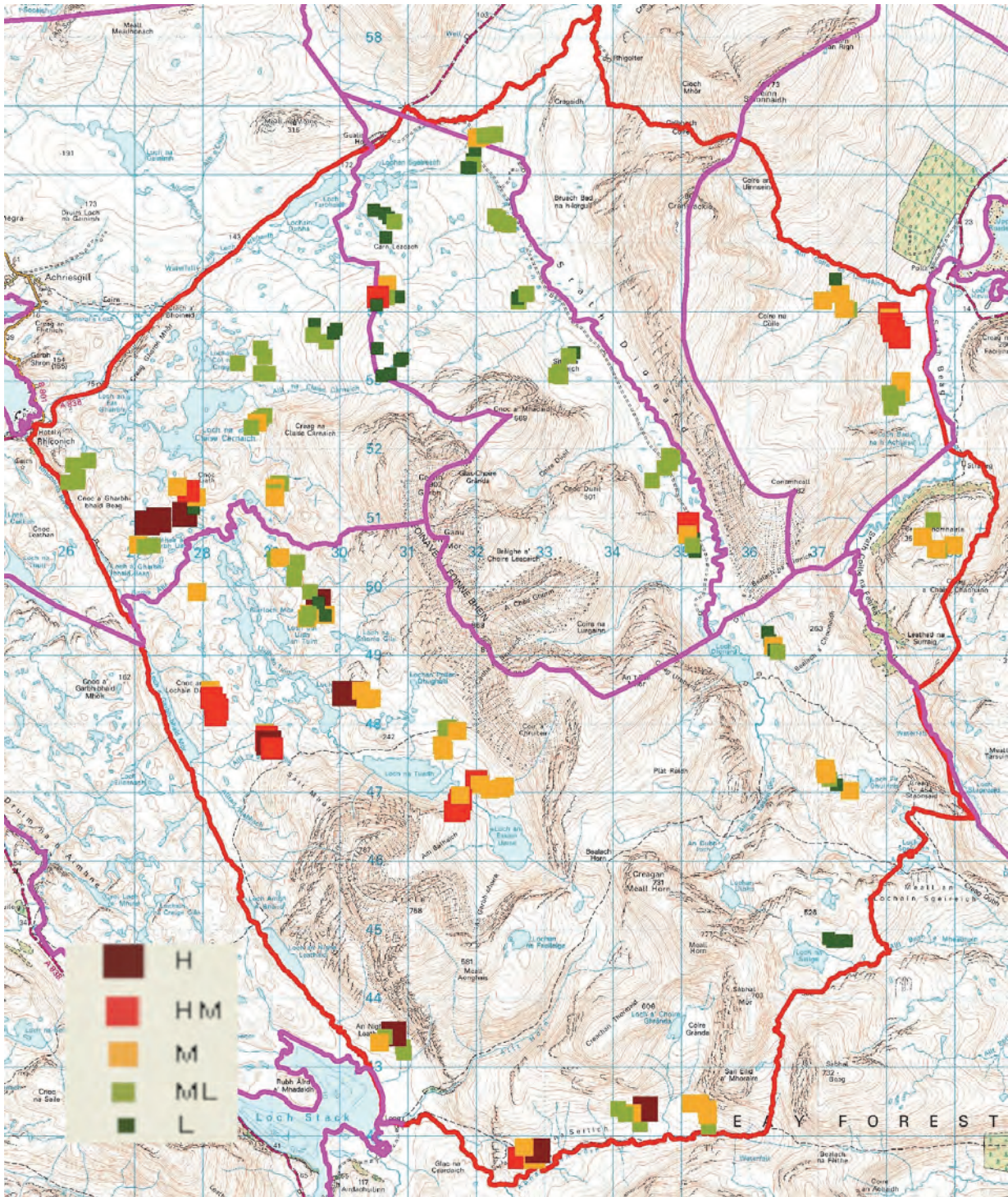
Map 2. Wet heath trampling impacts mean value by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



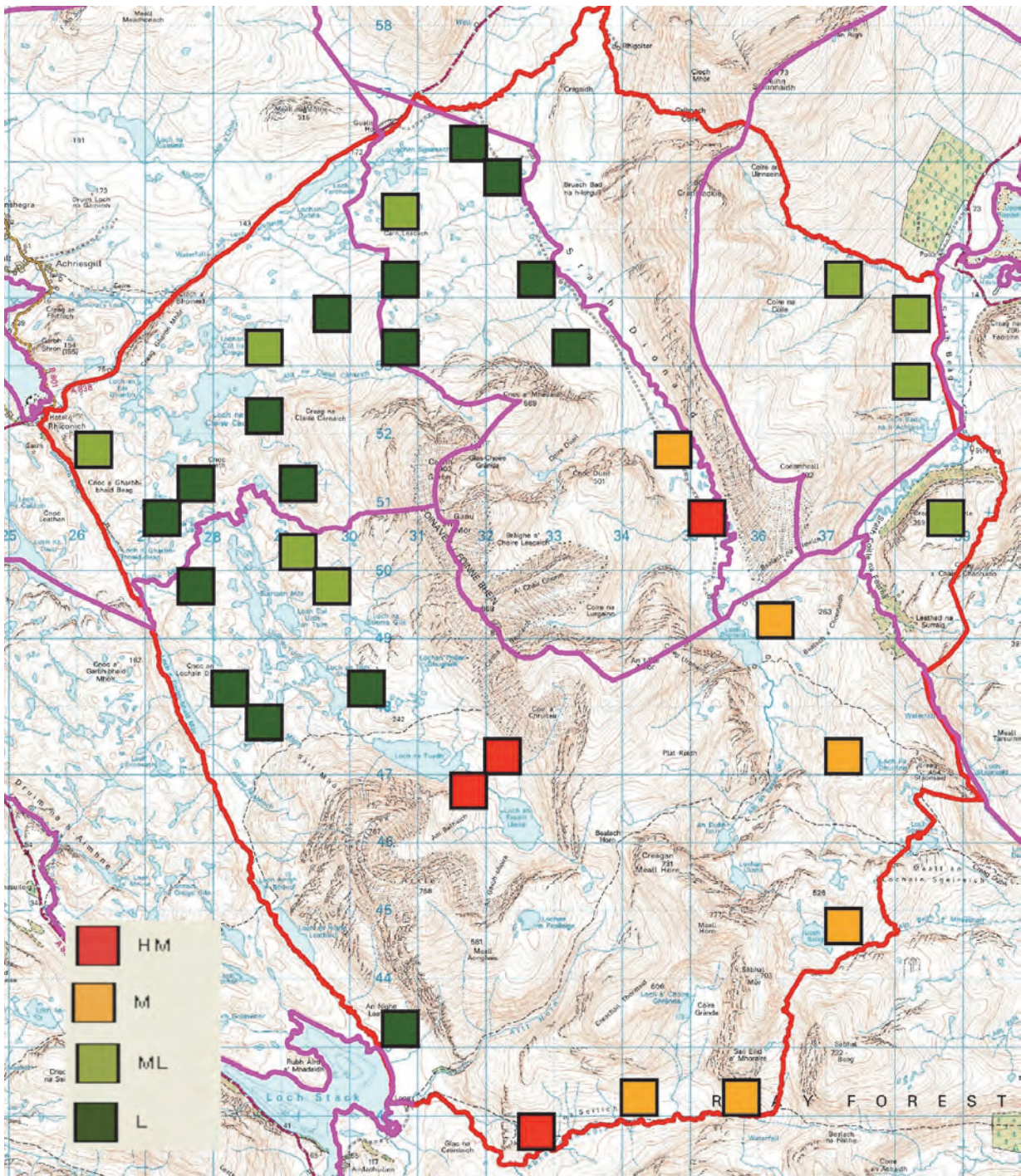
Map 3. Wet heath trampling impacts by individual monitoring plot. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



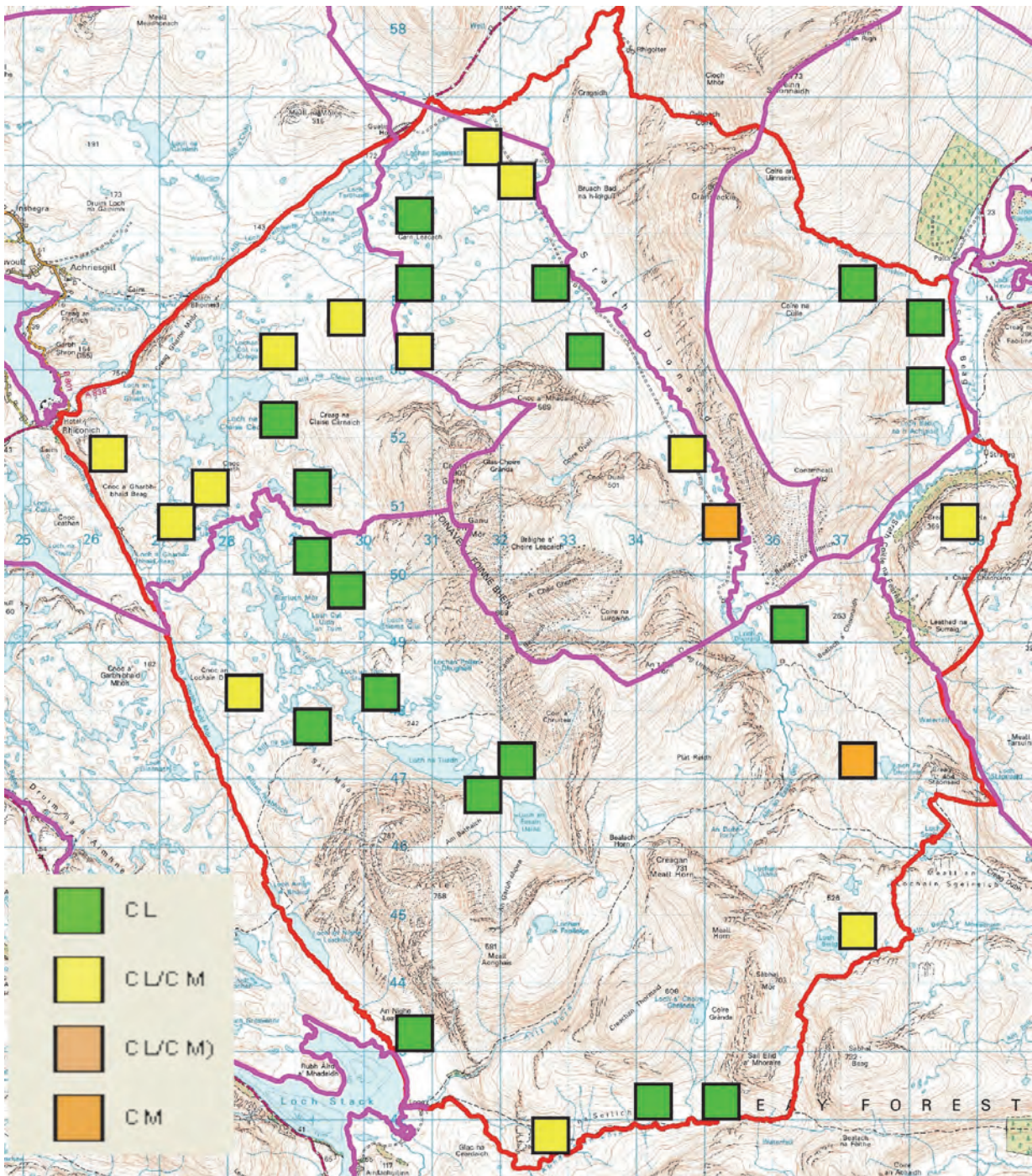
Map 4. Wet heath browsing impacts mean value by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



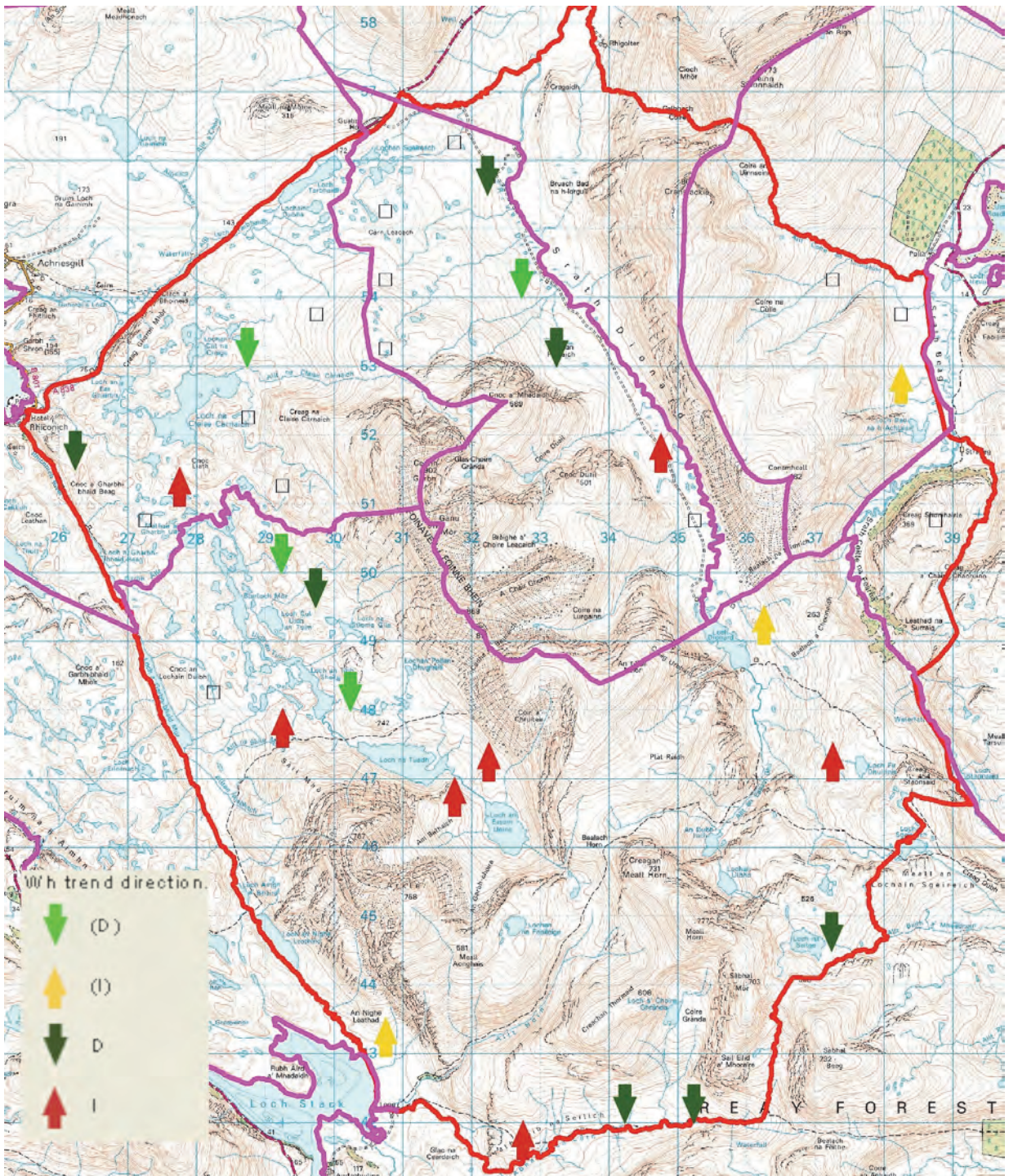
Map 5. Wet heath browsing impacts by individual monitoring plot. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



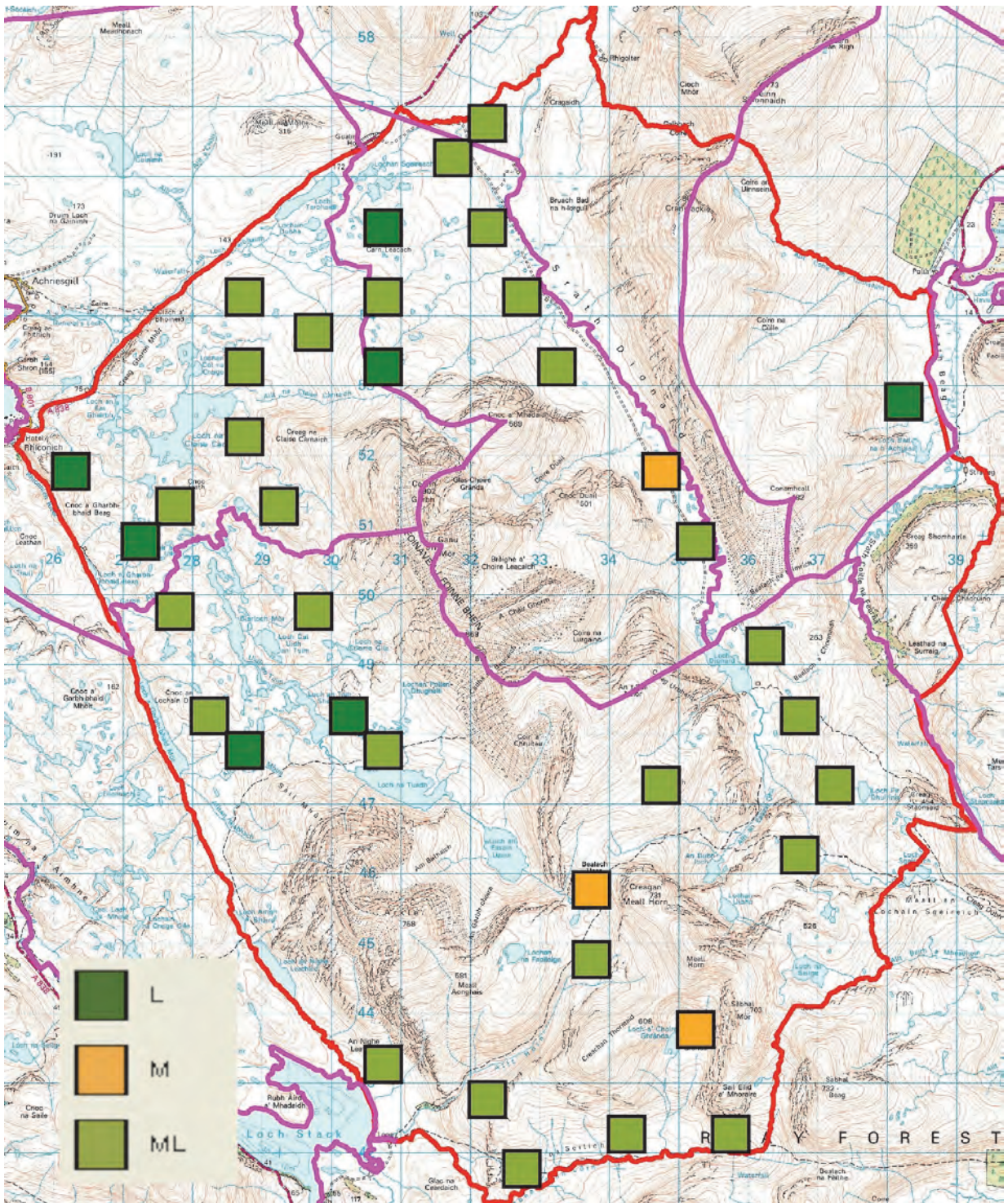
Map 6. Wet heath mean dung concentrations by individual monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



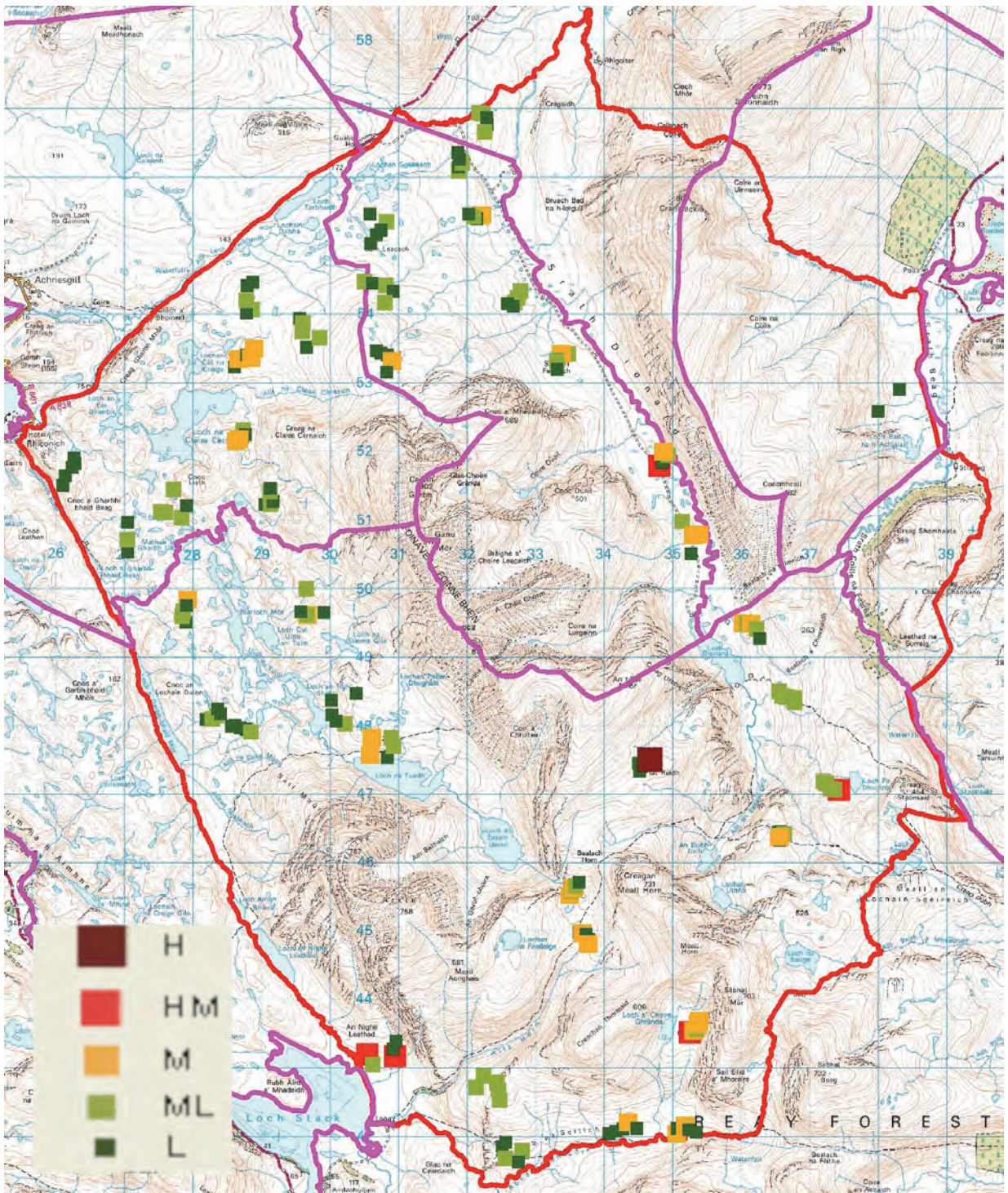
Map 7. Distribution of trend indicator classes within wet heath sample squares, where recorded. CL- 'Chronic Low'; CL/CM- 'Chronic Low-Chronic Moderate'; CM- 'Chronic Moderate'. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



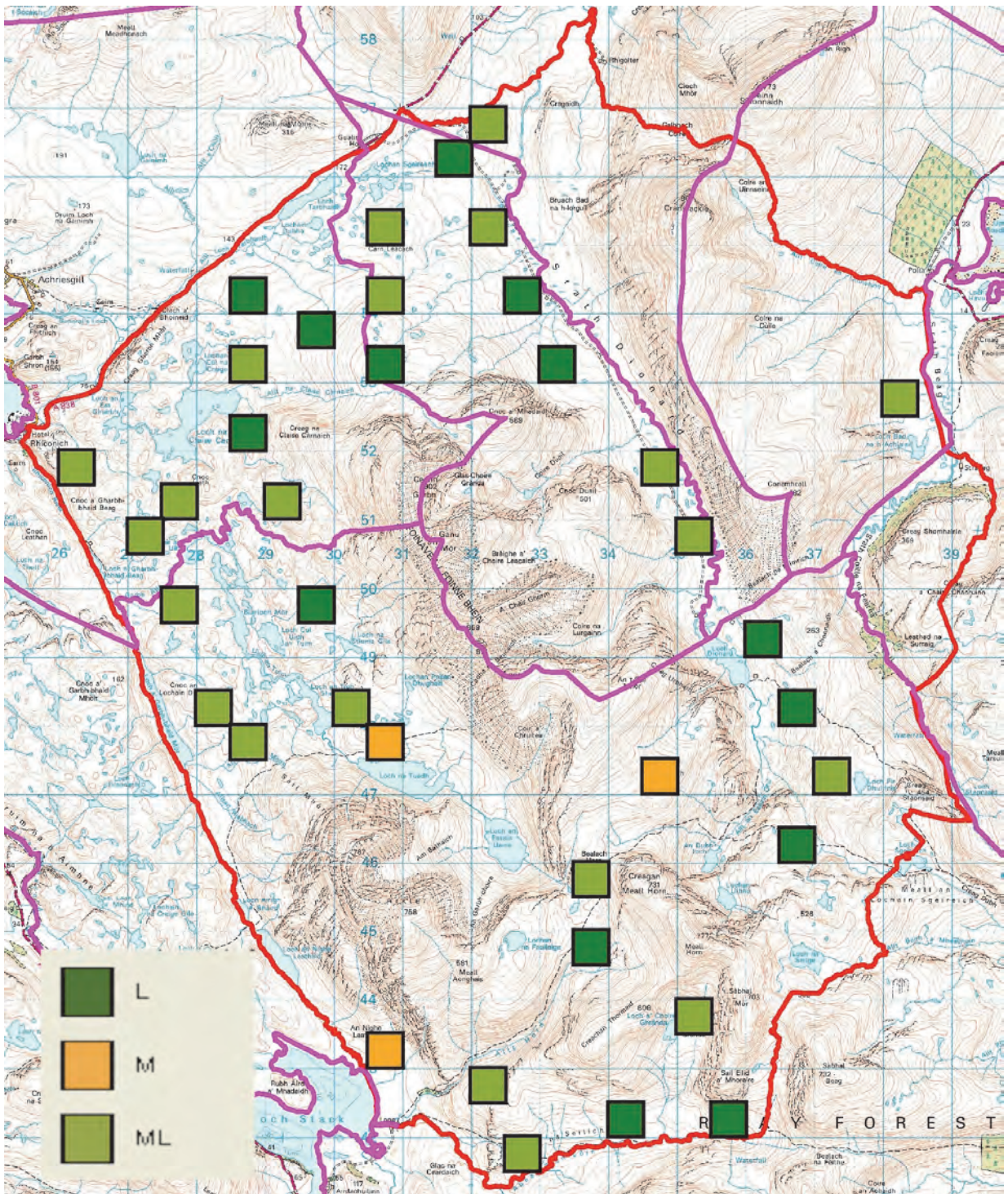
Map 8. Distribution of trend indicator direction within wet heath sample squares, where recorded. D- 'Declining'; (D)- 'One plot shows Declining'; I- 'Increasing'; (I) -'One plot shows increasing trend'. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



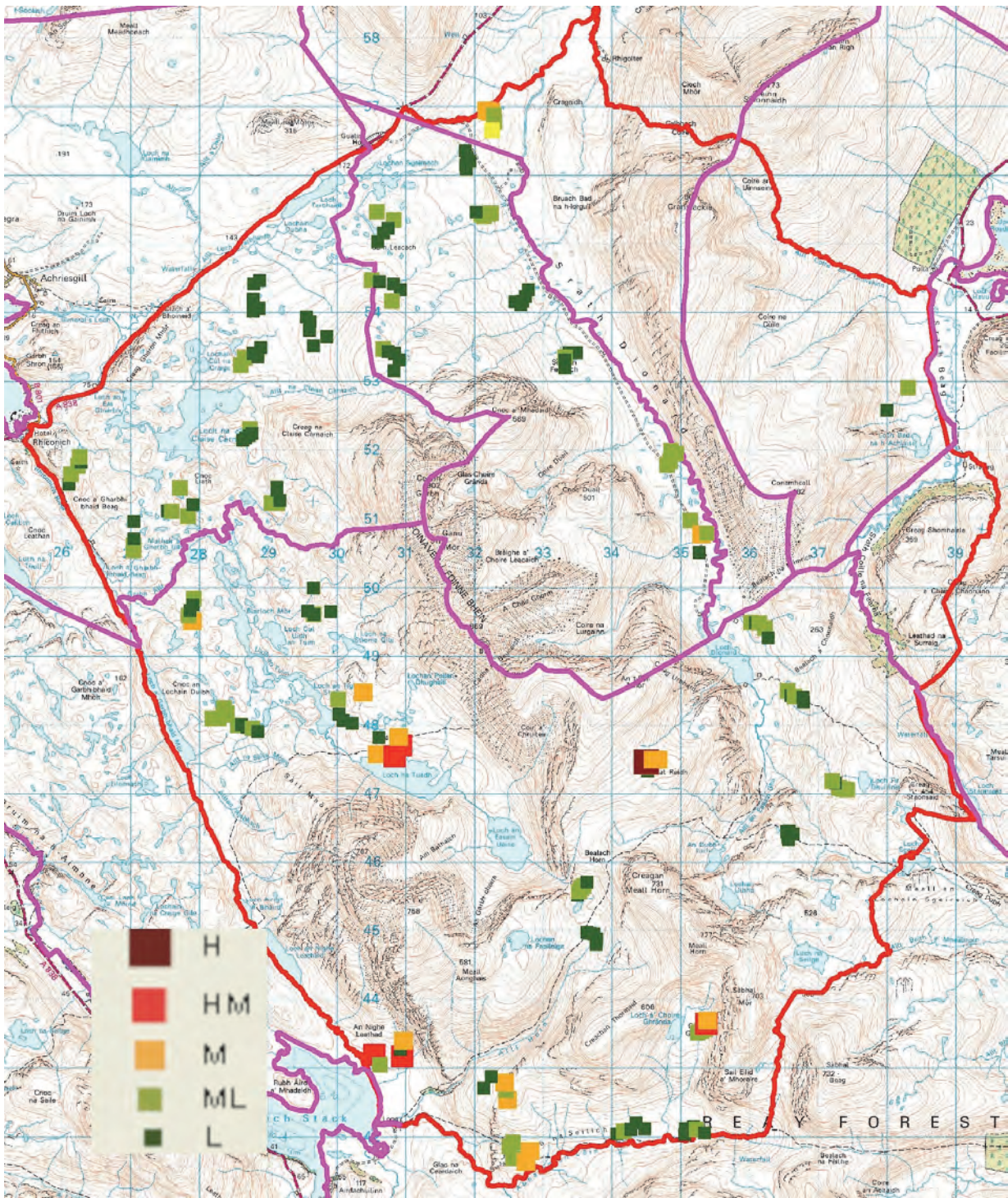
Map 9. Blanket bog mean trampling values by individual monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



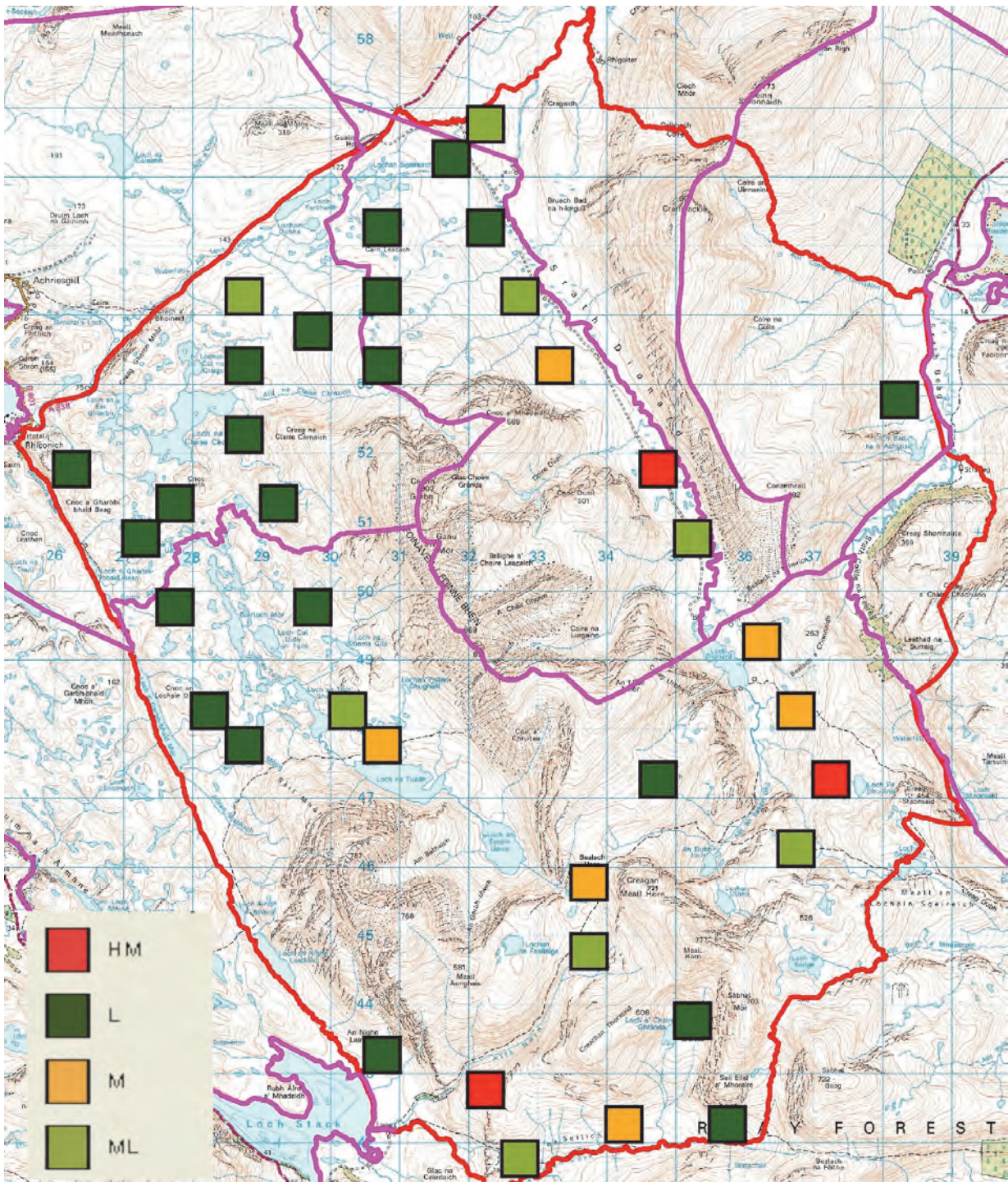
Map 10. Blanket bog tramplung impacts by individual monitoring plot. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



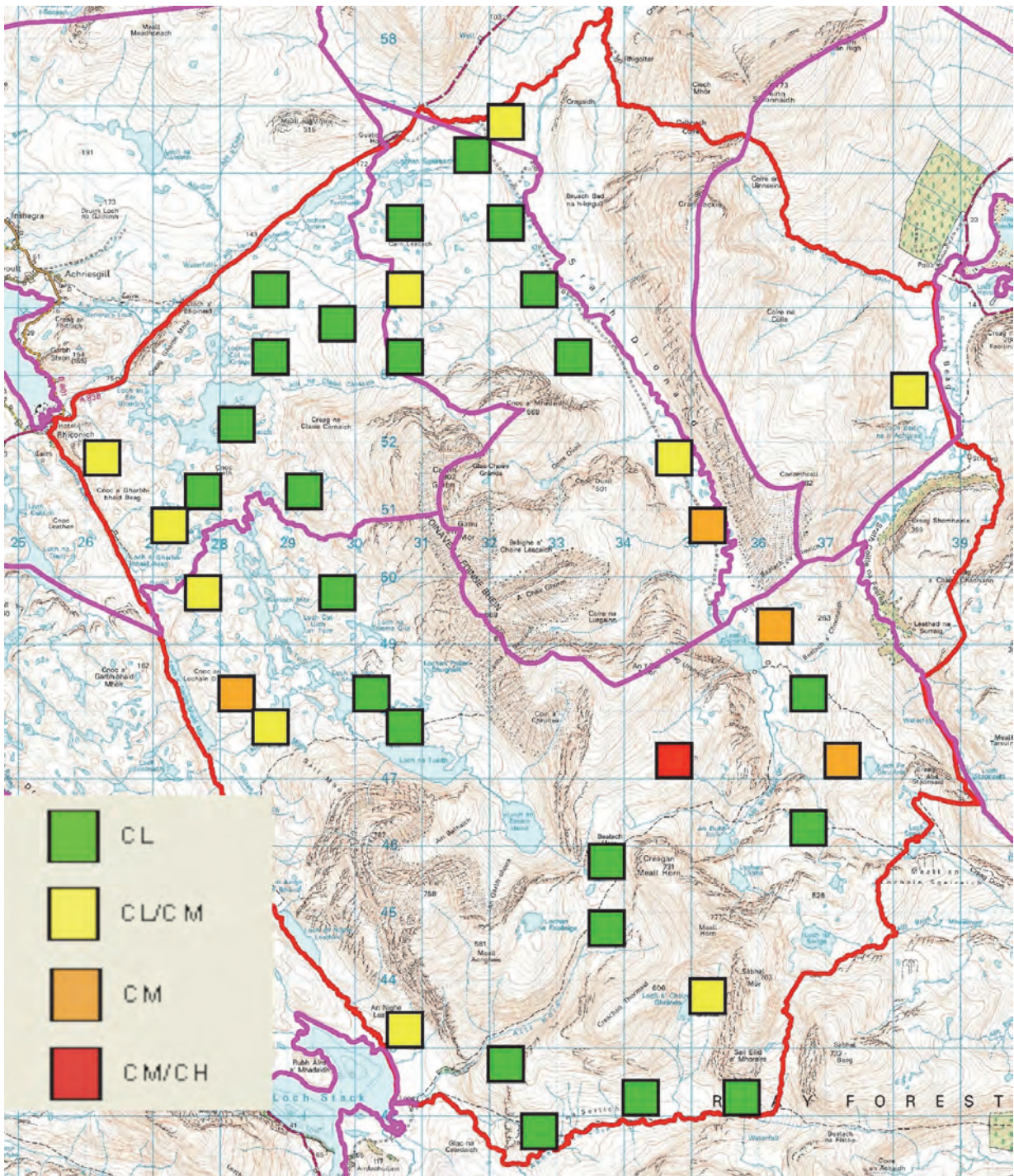
Map 11. Blanket bog mean browsing impacts by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



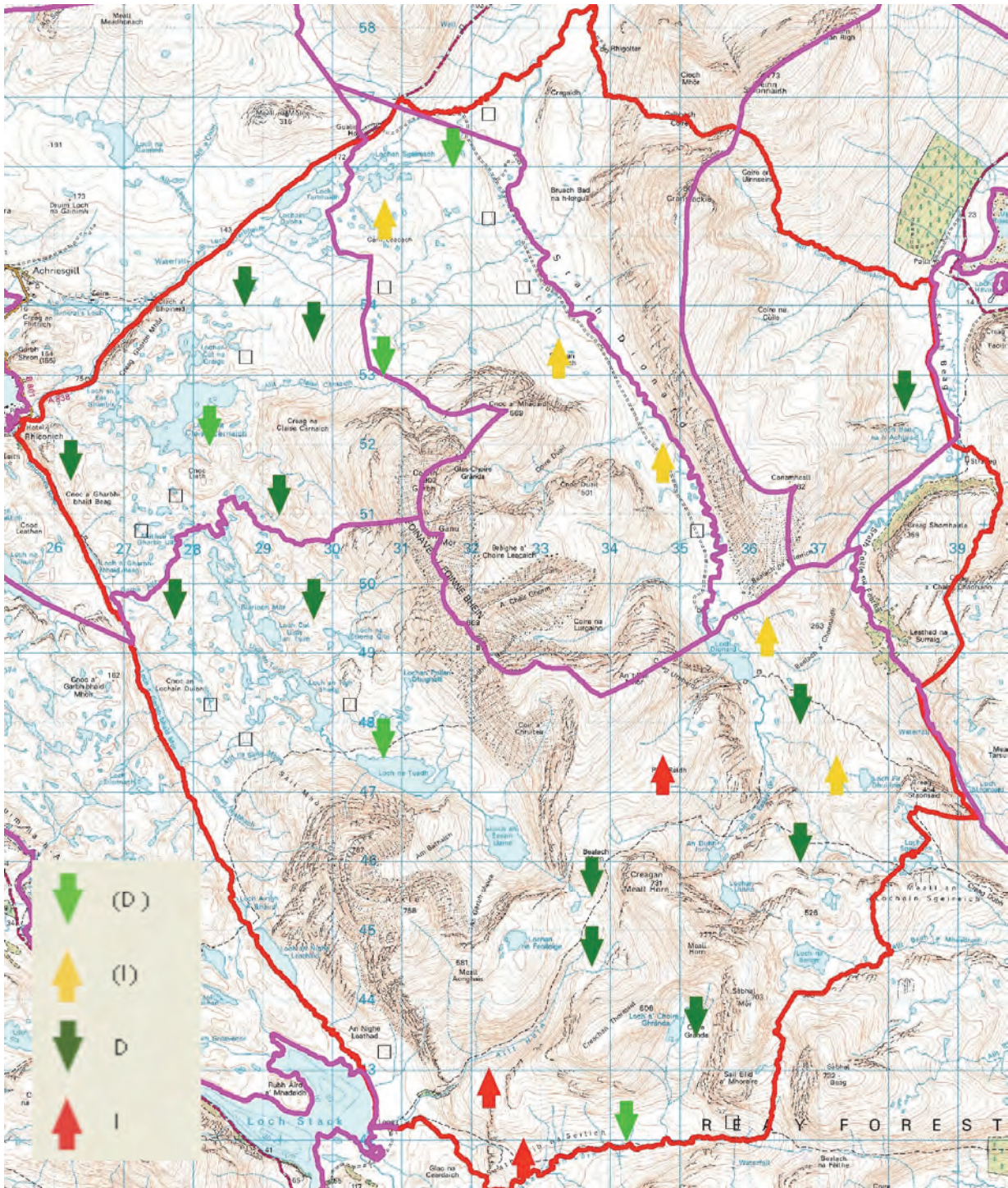
Map 12. Blanket bog browsing impacts by individual monitoring plot. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



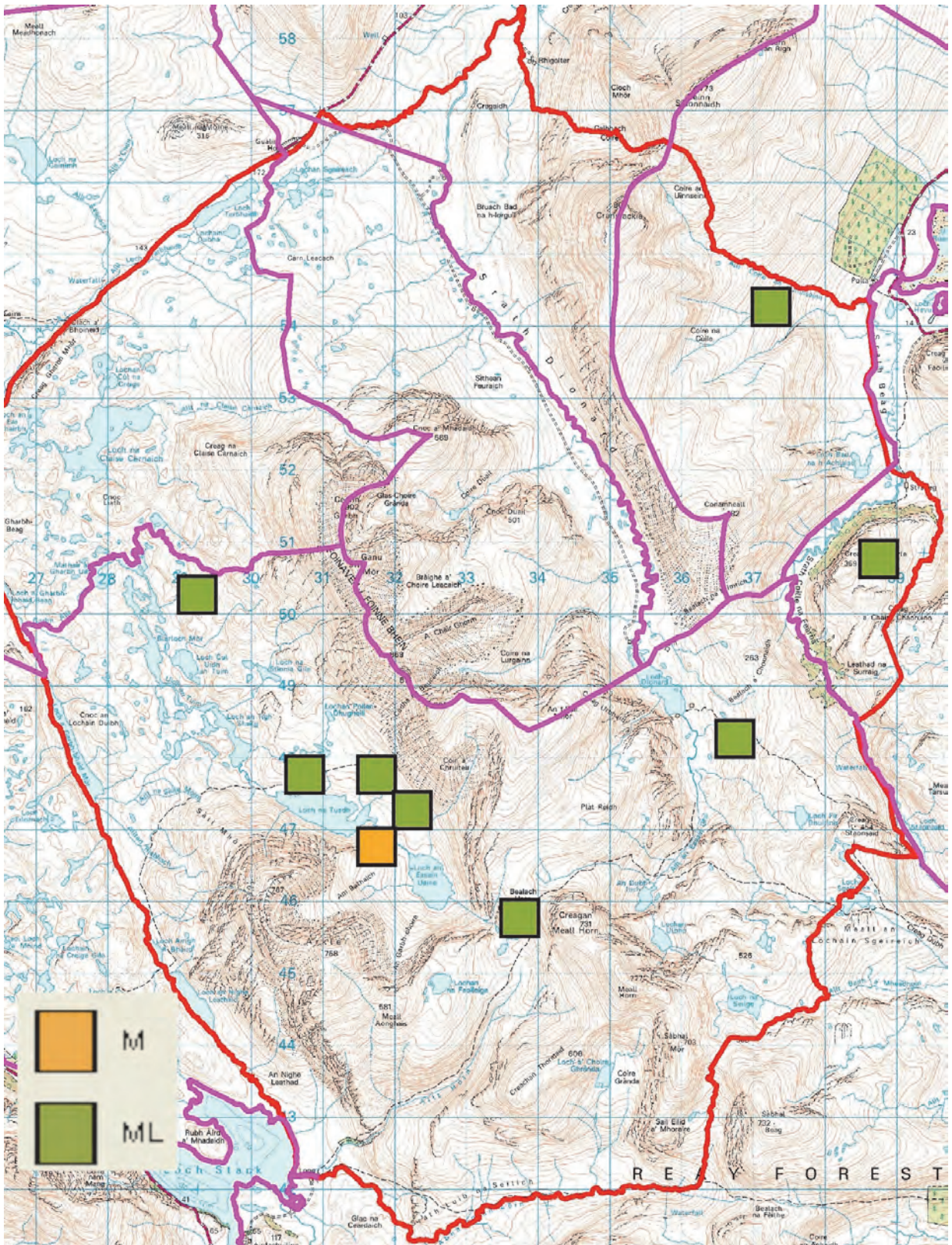
Map 13. Blanket bog mean dung pellet concentrations by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



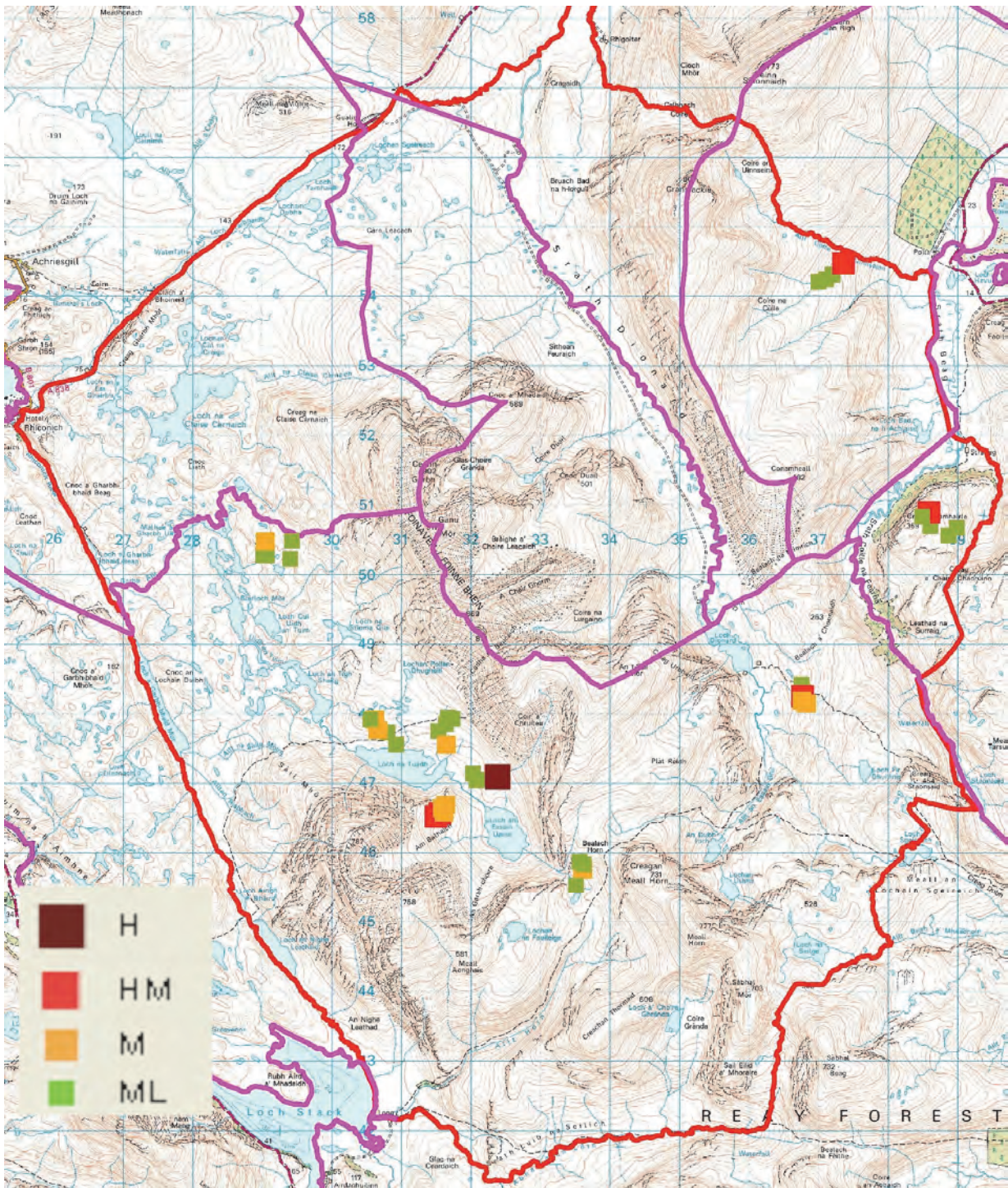
Map 14. Distribution of trend indicator classes within blanket bog sample squares, where recorded. CL- 'Chronic Low'; CL/CM- 'Chronic Low-Chronic Moderate'; CM- 'Chronic Moderate'; CM/CH-'Chronic Moderate-Chronic High'. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



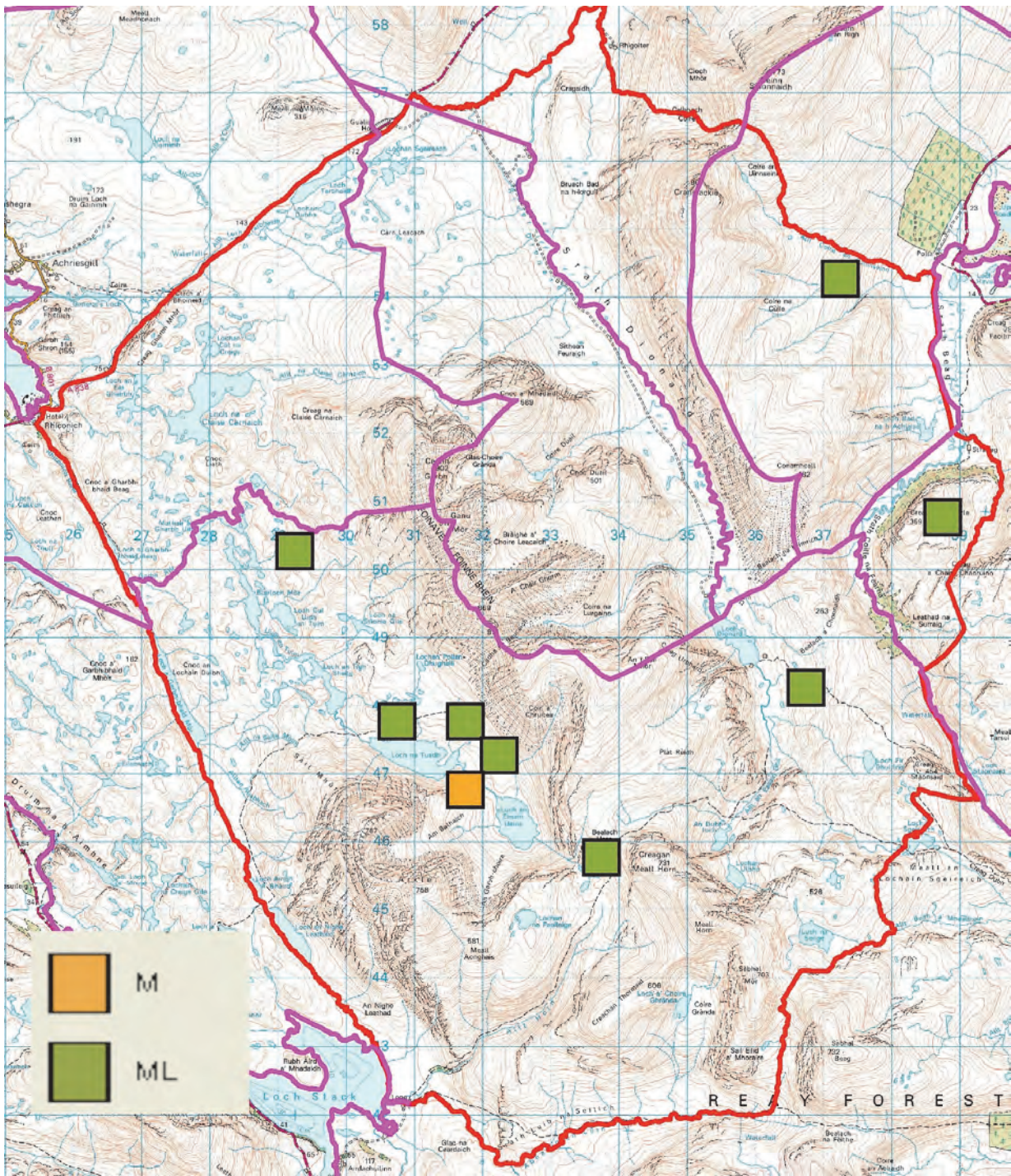
Map 15. Distribution of trend indicator direction within blanket bog sample squares, where recorded. D- 'Declining'; (D) – 'One plot shows declining trend'; I- 'Increasing'; (I)-'One plot shows increasing trend'. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



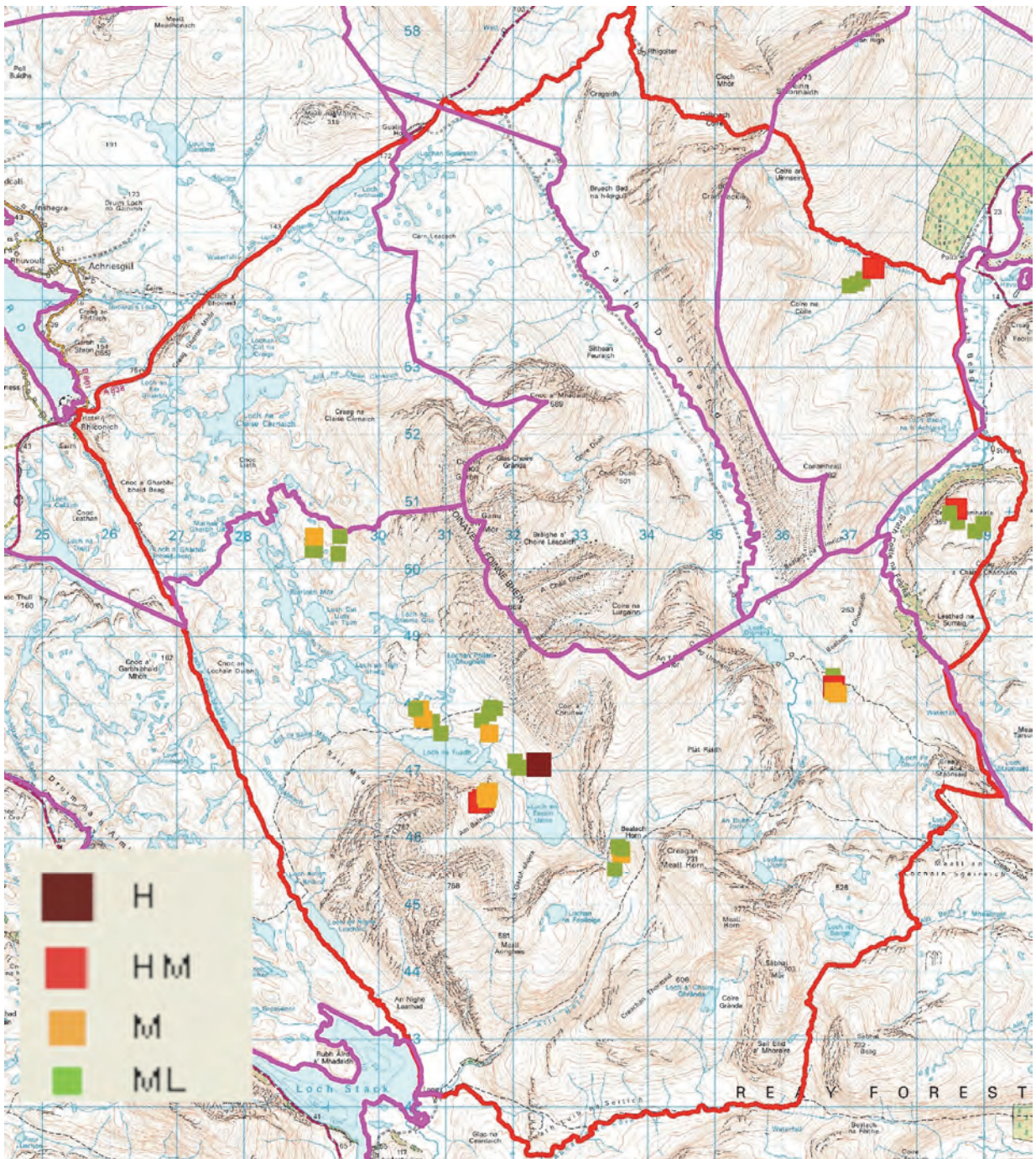
Map 16. Dry heath mean trampling impacts by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



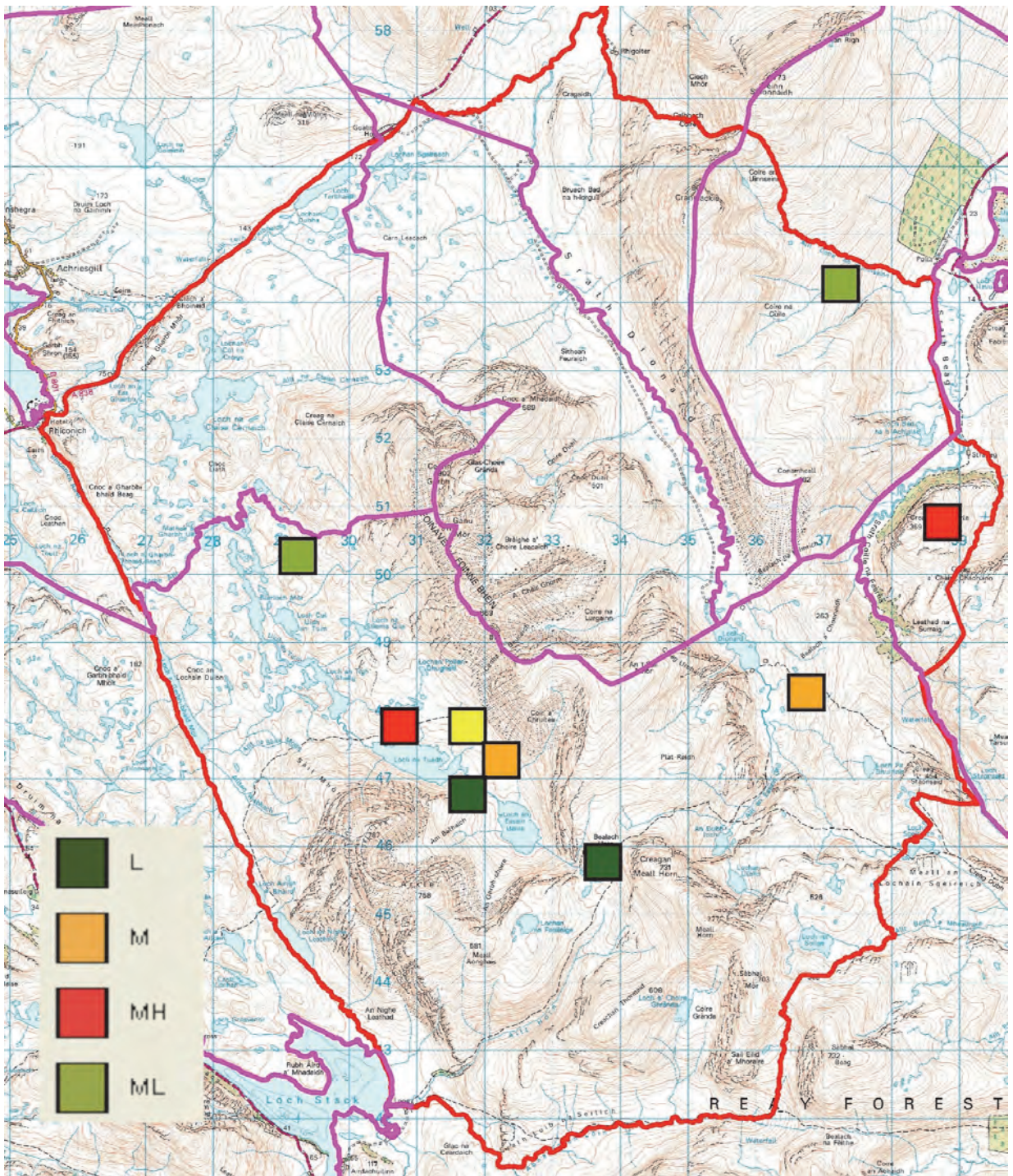
Map 17. Dry heath trampling impacts by individual monitoring plot. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



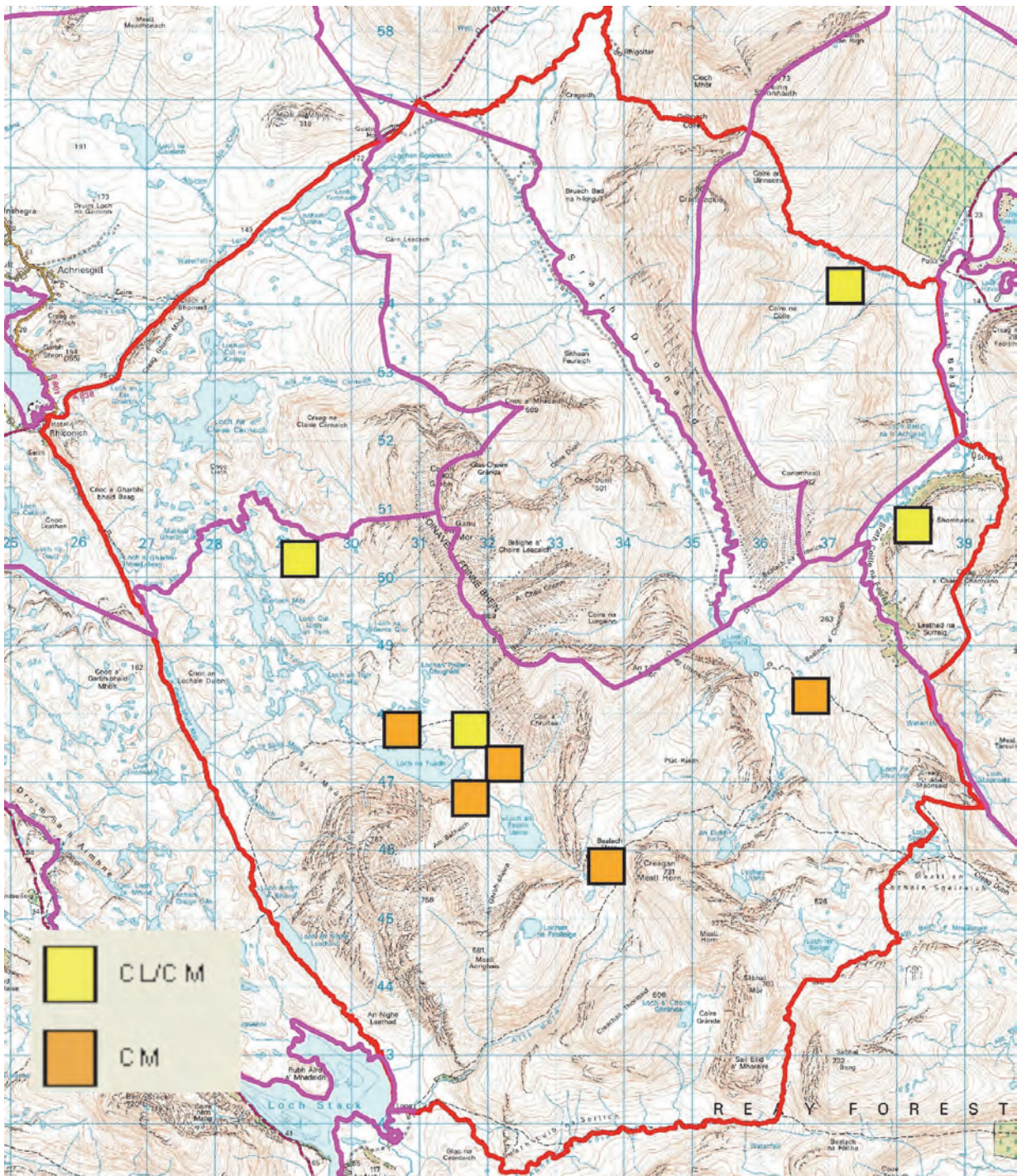
Map 18. Dry heath mean browsing impacts by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



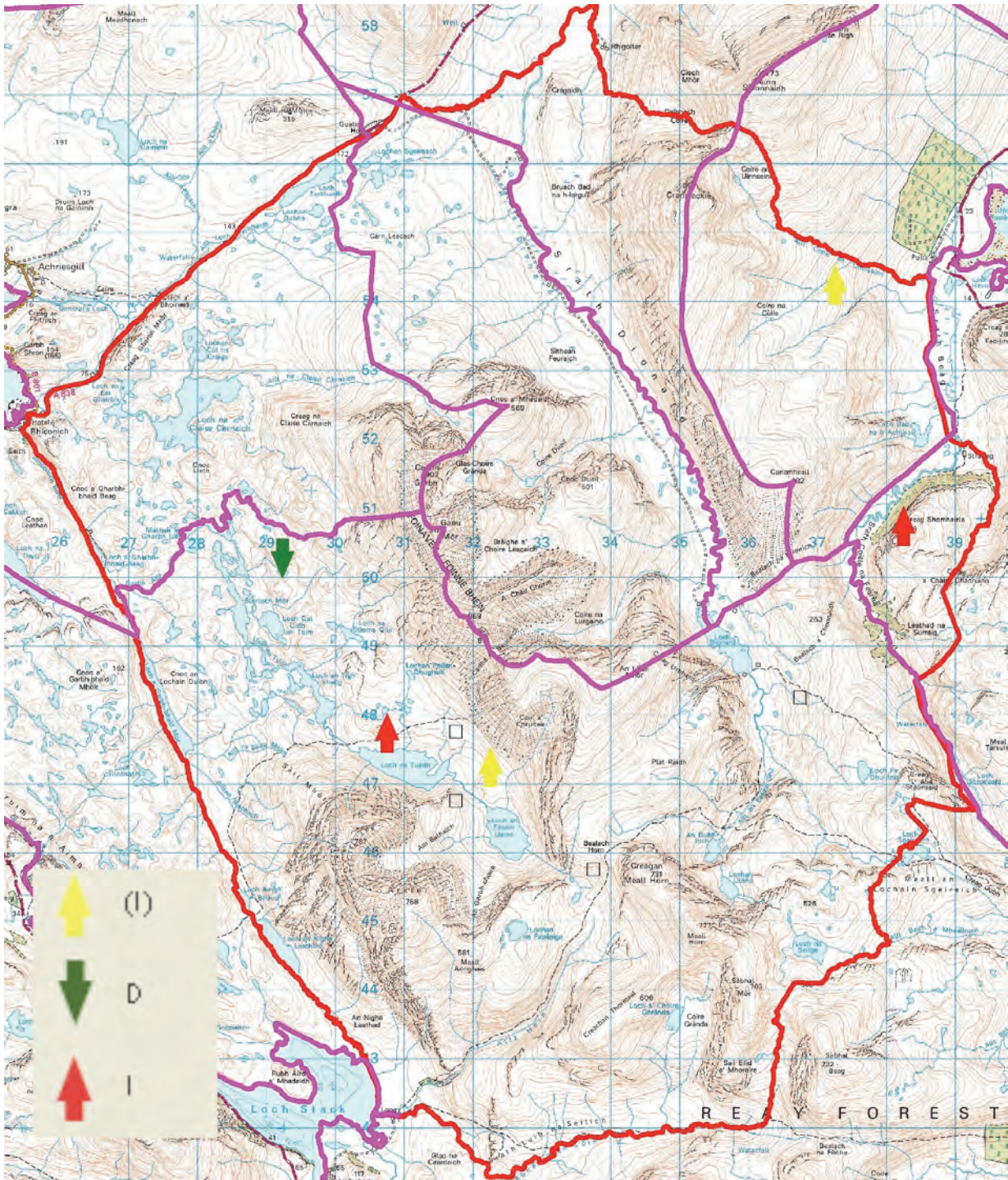
Map 19. Dry heath browsing impacts by individual monitoring plot. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



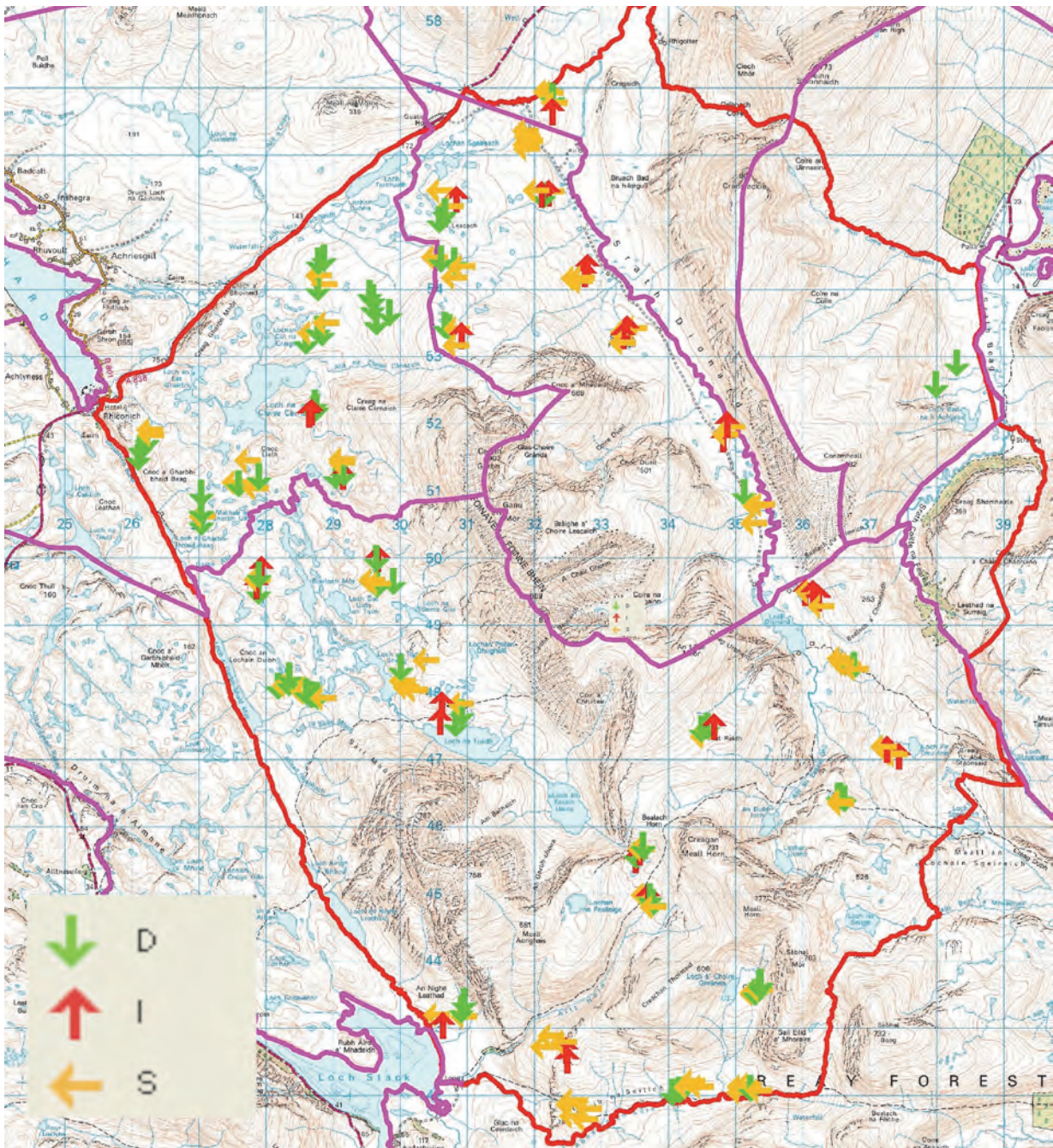
Map 20. Dry heath mean dung pellet concentration by monitoring square. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



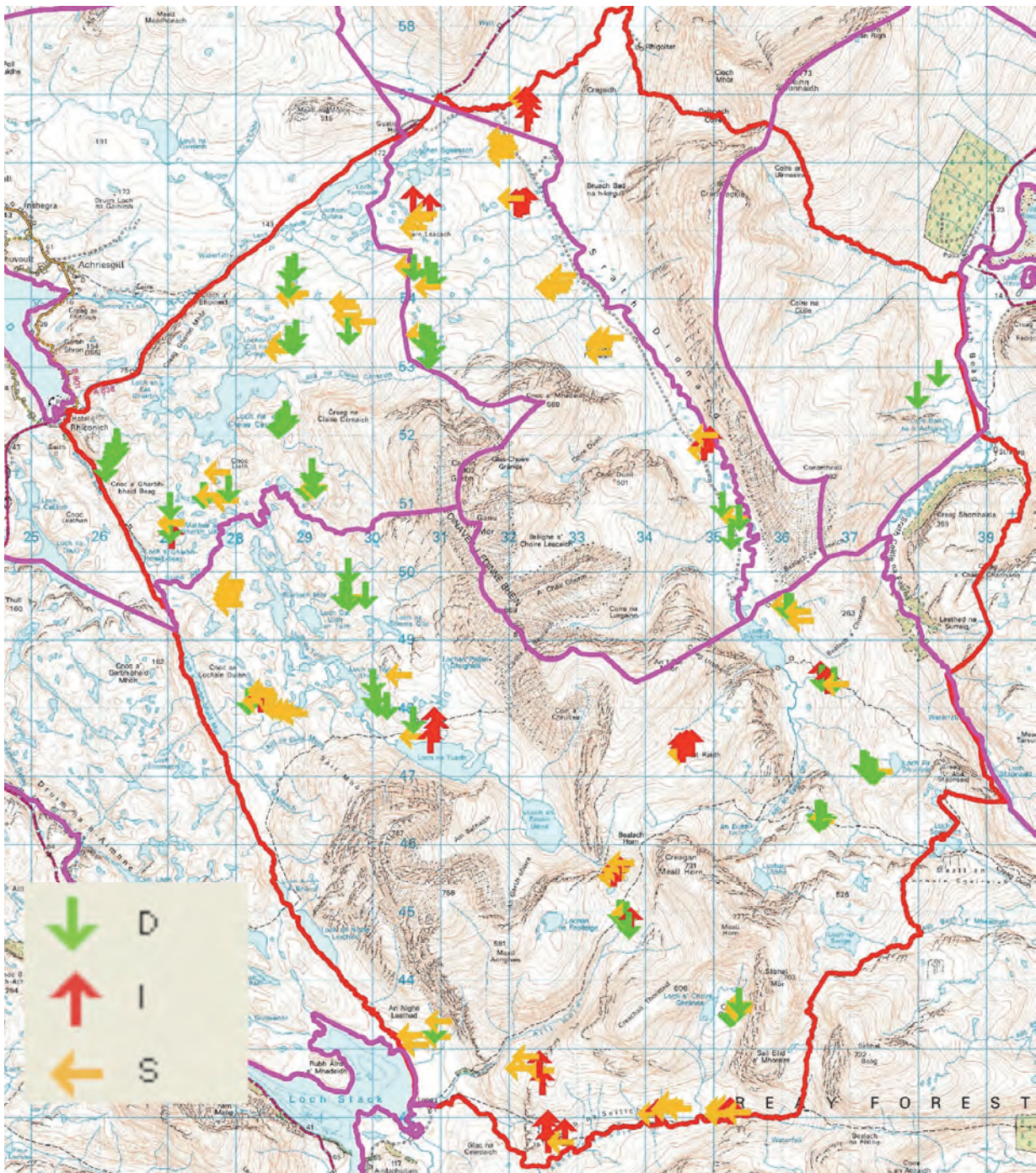
Map 21. Distribution of trend indicator classes within dry heath sample squares, where recorded. CL/CM- 'Chronic Low-Chronic Moderate'; CM- 'Chronic Moderate'. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



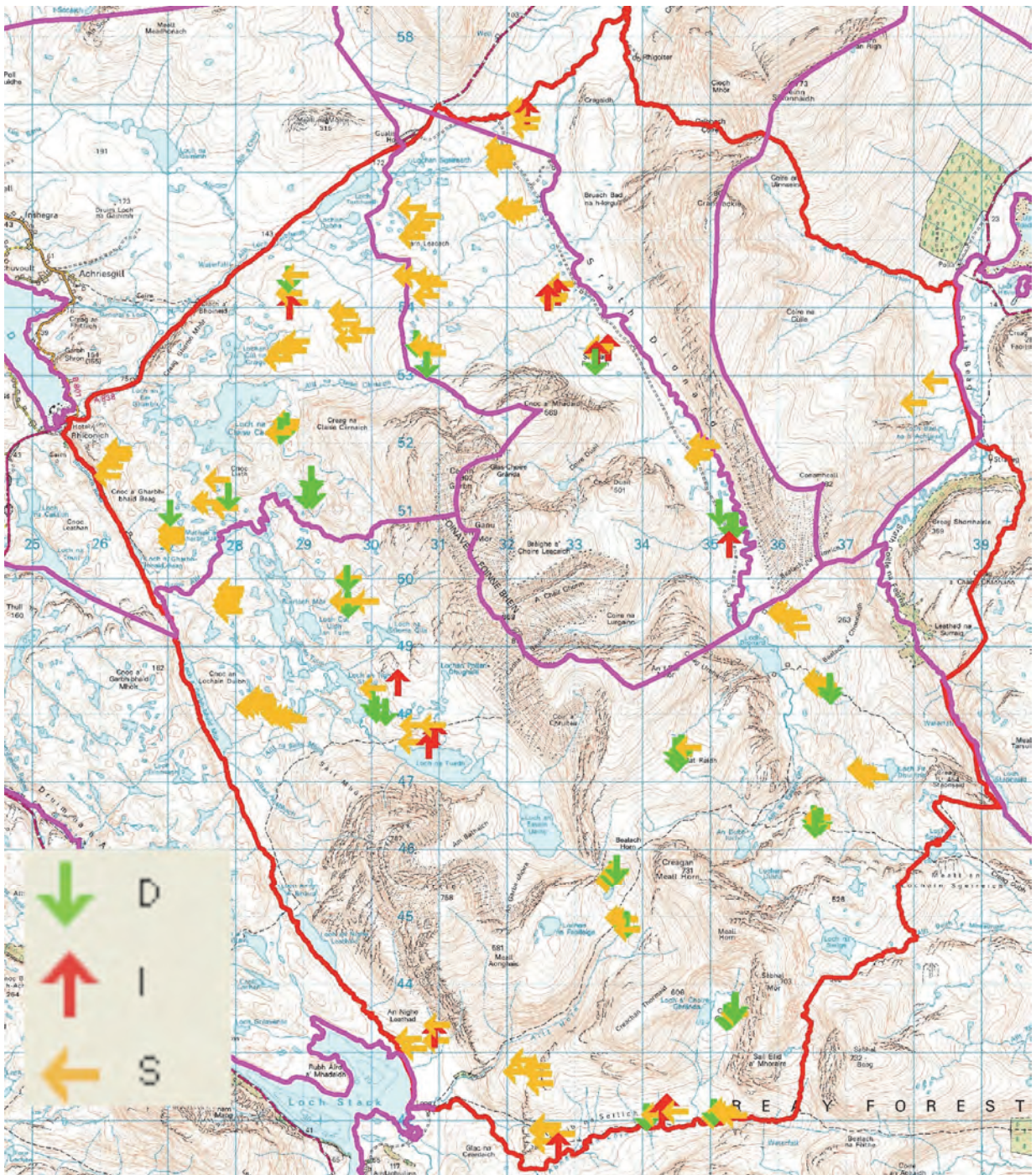
Map 22. Distribution of trend indicator direction within dry heath sample squares, where recorded. D- 'Declining'; (D)- 'One plot shows Declining trend'; I- 'Increasing'; (I)- 'One plot shows increasing trend'. HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



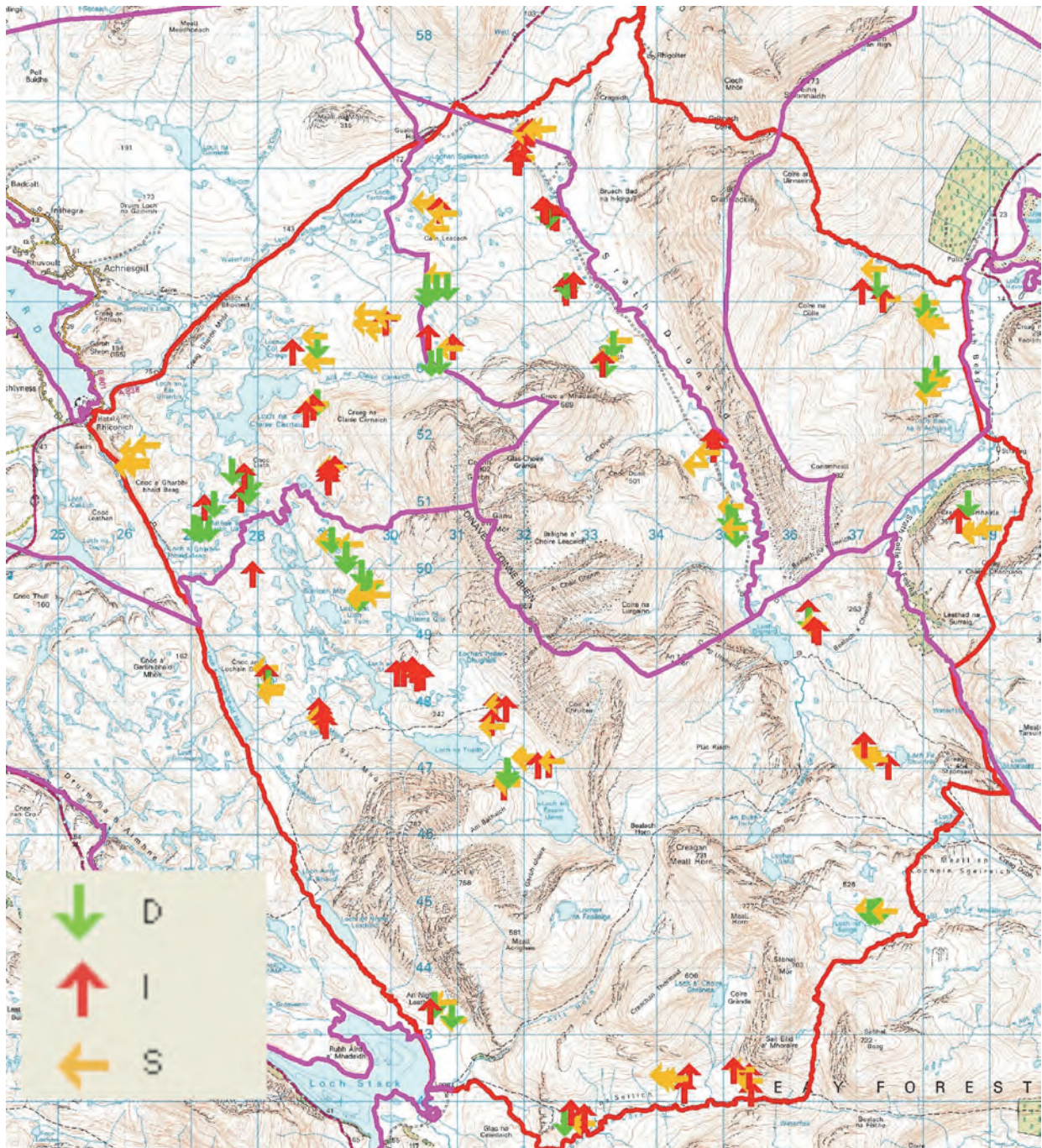
Map 23. Blanket bog trampling impact changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



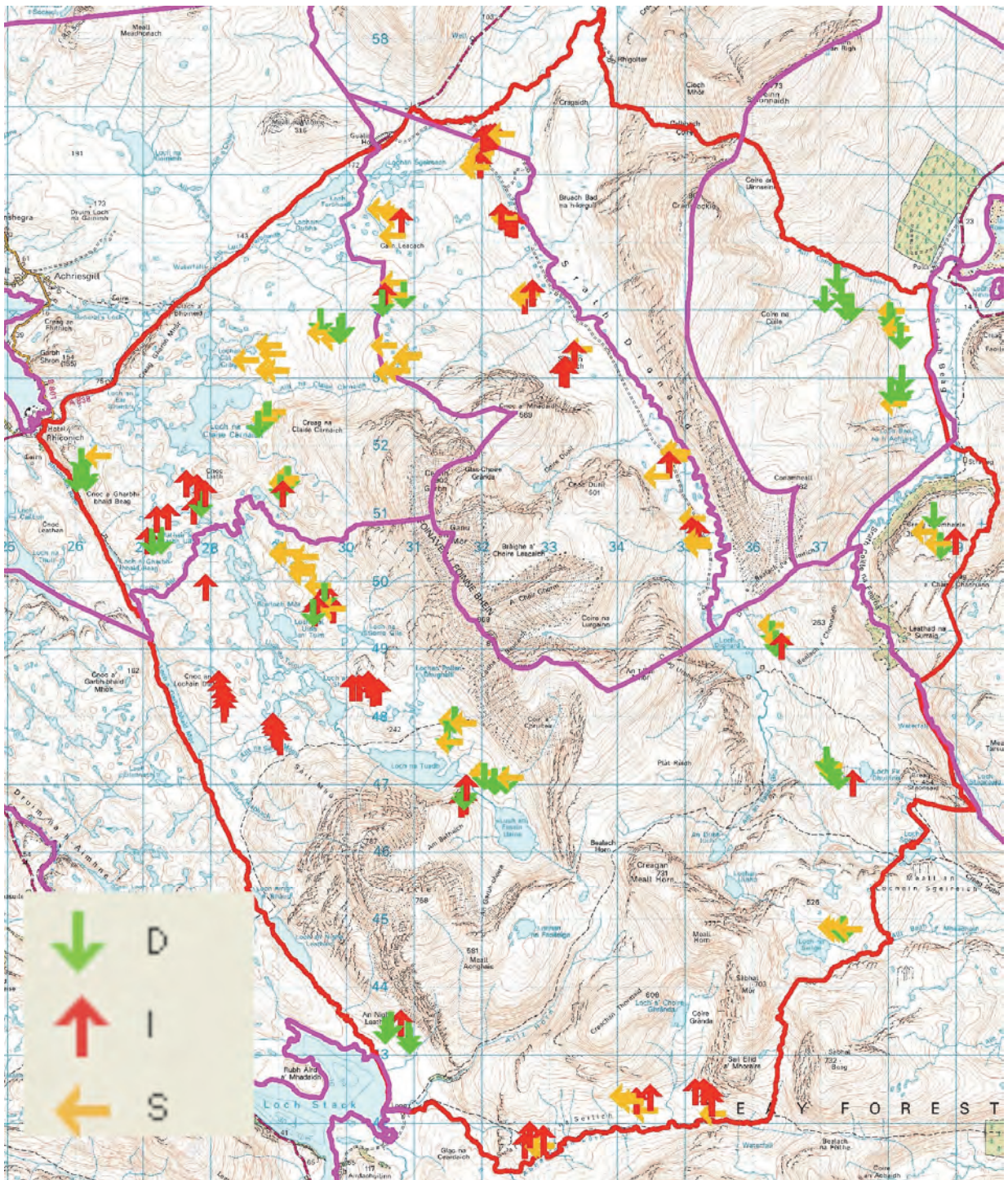
Map 24. Blanket bog browsing impact changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



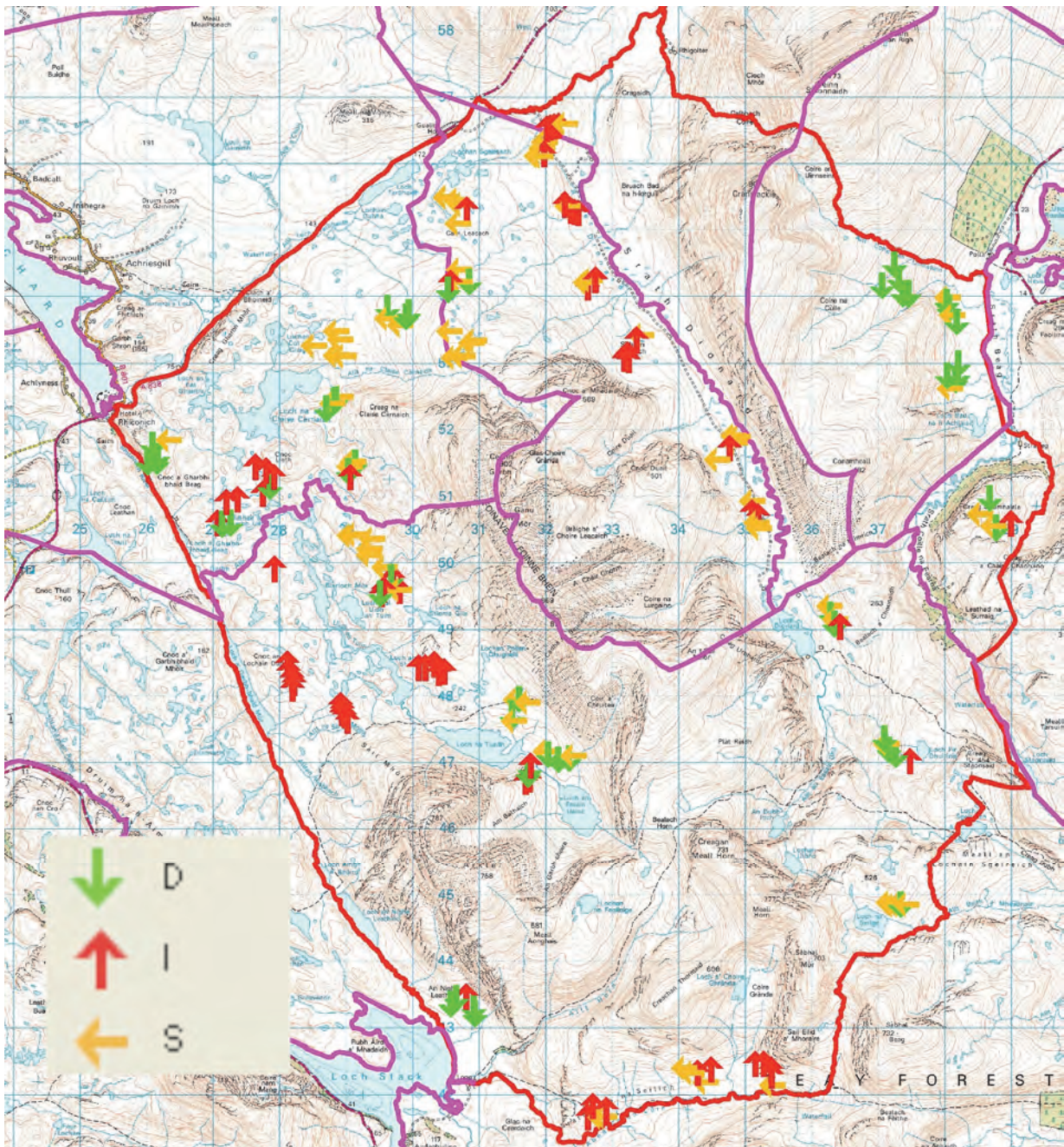
Map 25. Blanket bog dung concentration changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



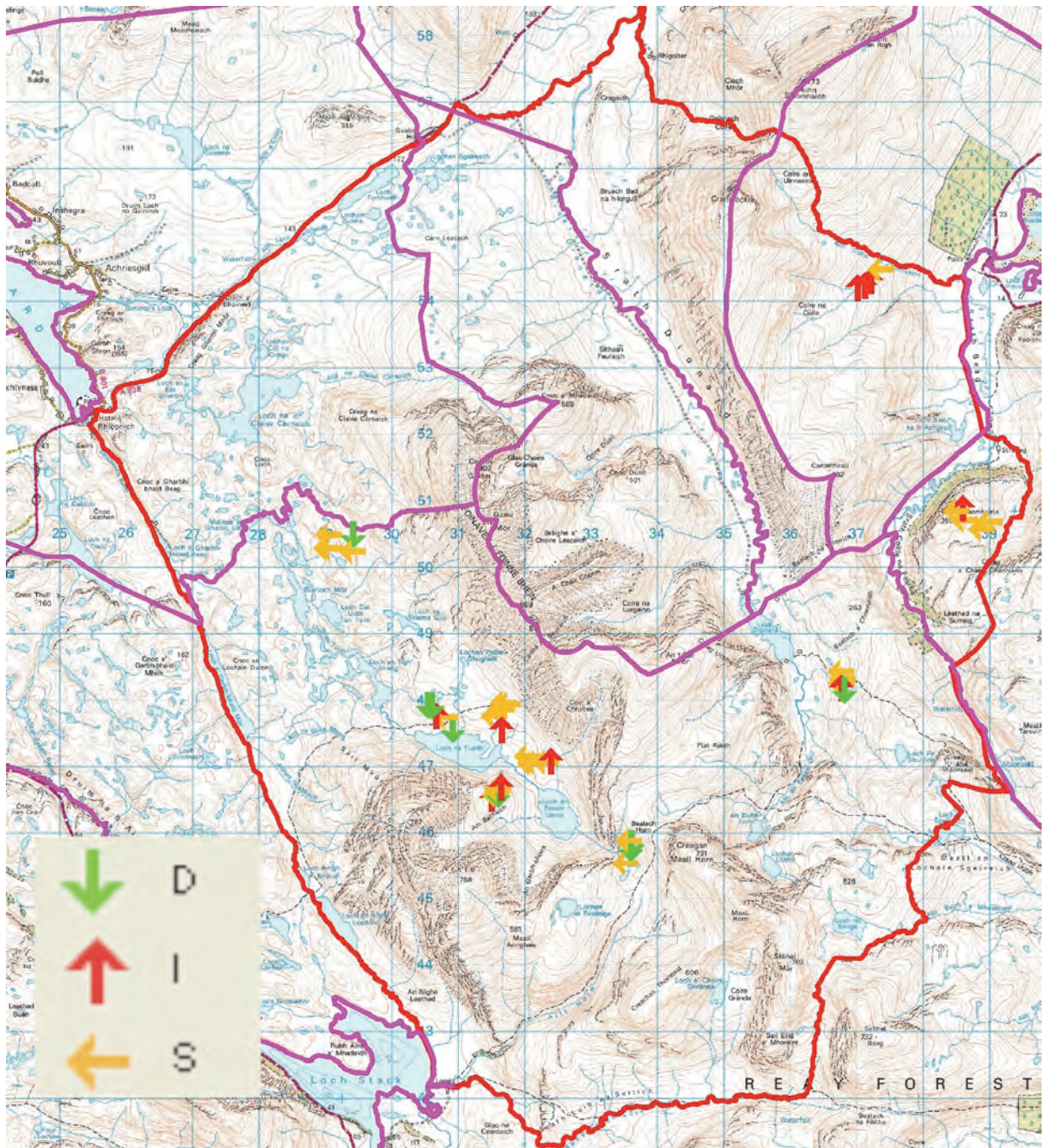
Map 26. Wet heath trampling impact changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



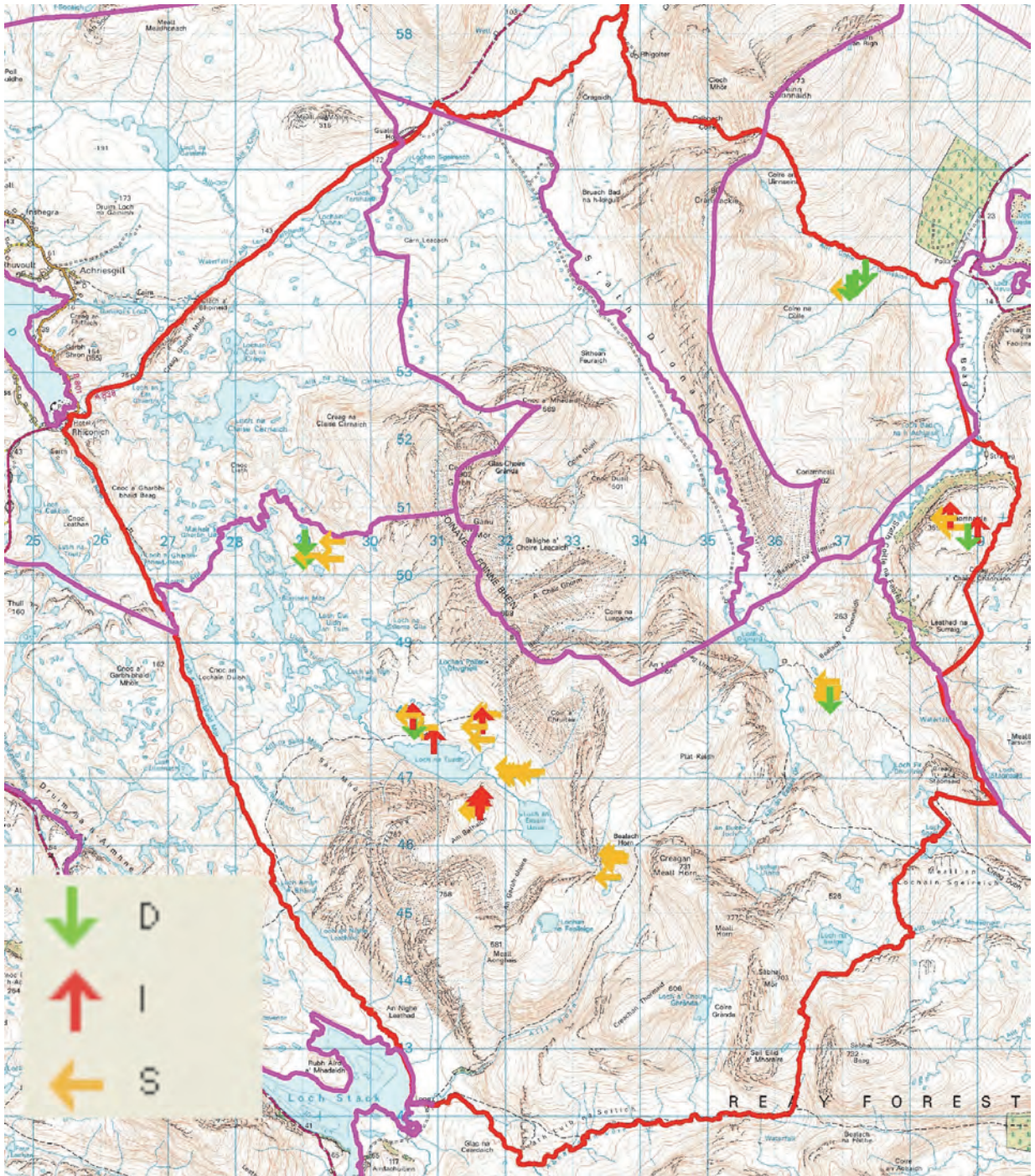
Map 27. Wet heath browsing impact changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



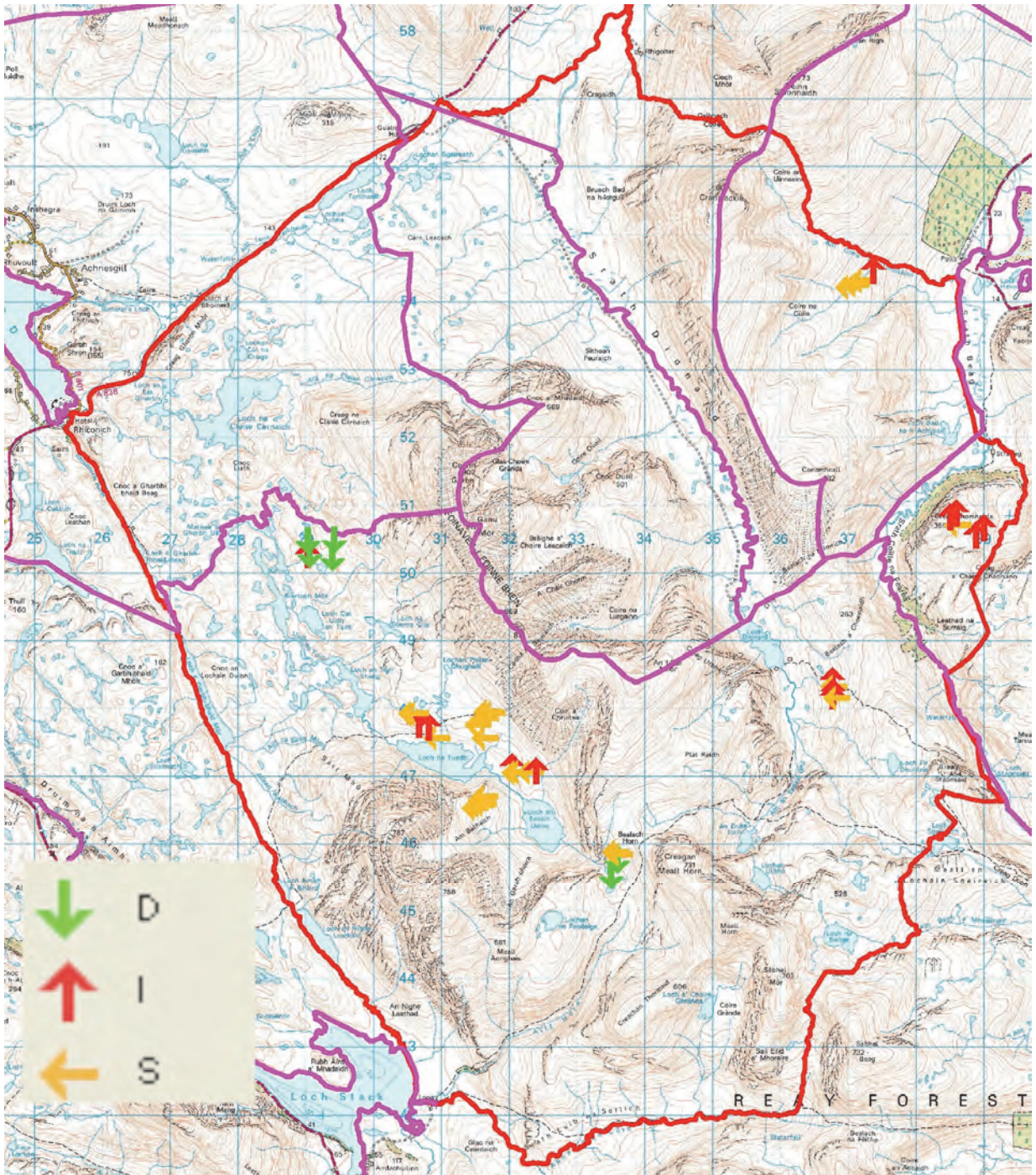
Map 28. Wet heath dung concentration changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



Map 29. Dry heath trampling impact changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



Map 30. Dry heath browsing impact changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.



Map 31. Dry heath dung concentration changes 2010-2015 by individual monitoring plot. (D- Decline; I- Increase; S- Stable). HMSO. © Crown copyright and database rights 2015. All rights reserved. OS Licence Number 100017908.

ANNEX 3: INDICATORS USED

2015 Indicators

Squares highlighted in yellow mark those indicators which were modified or excluded (see Dayton & O’Hanrahan, 2011)

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding condition measures
Blanket bog	<i>Blanket Bog</i> <i>Wet heath</i>	Current trampling and grazing impacts	<ul style="list-style-type: none"> Trampling and grazing of pool systems and water tracks 	T	
			<ul style="list-style-type: none"> Trampling of <i>Sphagnum</i> moss hummocks and lawns 	T	Record the % of the plot covered by intact <i>Sphagnum</i> spp.
			<ul style="list-style-type: none"> Extent of ground cover by bryophytes and/or lichens among and between dwarf-shrub, sedge and grass plants 	T	
			<ul style="list-style-type: none"> Abundance of hoof prints in bare peat over the assessment unit 	T	Record what % of the plot has been disturbed by hoof prints. Record the % of the plot covered by bare peat. Record the % or the plot covered by re-vegetating bare peat, e.g. with established <i>E.angustifolium</i> .
			<ul style="list-style-type: none"> Firmness of ground underfoot 	T	
			<ul style="list-style-type: none"> Browsing of <i>Betula nana</i> 	G	

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding condition measures
			<ul style="list-style-type: none"> Signs of browsing on <i>Arctostaphylos uva-ursi</i>, <i>Empetrum nigrum</i>, <i>Erica tetralix</i> or <i>Vaccinium vitis-idaea</i> 	G	
			<ul style="list-style-type: none"> Amount of flower or fruit on <i>Rubus chamaemorus</i> 	G	
			<ul style="list-style-type: none"> Amount of flowering of <i>Eriophorum</i> spp. 	G	
			<ul style="list-style-type: none"> Growth-form and evidence of browsed shoots on <i>Myrica gale</i> bushes 	G	
			<ul style="list-style-type: none"> Conspicuousness of browsing on <i>Calluna vulgaris</i> or <i>Vaccinium myrtillus</i> 	G	Record what % of long shoots of <i>Calluna</i> and or <i>Vaccinium</i> are browsed. Record % for each species separately, based on an average assessment from 10 handfuls of shoots. Record the average height of dwarf shrub cover from 10 measures within the plot.
			<ul style="list-style-type: none"> Amount of herbivore dung present 	D	
	Grazing - impact trends		<ul style="list-style-type: none"> Changes in growth form recorded within the structure of dwarf-shrub bushes 	G	
			<ul style="list-style-type: none"> Height of <i>Myrica gale</i> 	G	
			<ul style="list-style-type: none"> Height and cover of dwarf shrubs relative to graminoids 	G	
			<ul style="list-style-type: none"> Abundance of <i>Juncus squarrosus</i> and its growth relative to other vegetation components 	G	

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding condition measures
			<ul style="list-style-type: none"> Presence of species more typical of drier grassland such as <i>Agrostis canina</i>, <i>A. capillaris</i>, <i>Anthoxanthum odoratum</i>, <i>Deschampsia flexuosa</i>, <i>Festuca ovina</i> and <i>Nardus stricta</i> 	G	
			<ul style="list-style-type: none"> <i>Carex panicea</i> abundant on drier "ridge" elements of bog patterning 	T	
		Herbivore species present	<ul style="list-style-type: none"> Record which herbivore species are present and whether impacts are clearly attributable to one or more species. 		
Dwarf shrub heath	Dry heaths	Current browsing impact	<ul style="list-style-type: none"> Signs of browsing on <i>Arctostaphylos uva-ursi</i>, <i>Empetrum nigrum</i>, <i>Erica tetralix</i> or <i>Vaccinium vitis-idaea</i> (or associated <i>Nardus stricta</i>) 	G	
			<ul style="list-style-type: none"> Average proportion of long-shoots of <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> showing signs of having been browsed 	G	Record what % of long-shoots of <i>Calluna</i> and or <i>Vaccinium</i> are browsed. Record % for each species separately, based on an average assessment from 10 handfuls of shoots. Record the average height of dwarf shrub cover, from 10 measures within the plot.
			<ul style="list-style-type: none"> Amount of flower or fruit on <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> 	G	
			<ul style="list-style-type: none"> Summer browsing of <i>Calluna vulgaris</i> 	G	
			<ul style="list-style-type: none"> Type of shoot material removed from <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> 	G	

Habitat category for assessment in MacDonald <i>et al.</i> (1998)	Designated features for which indicators to be used	Type of indicator	Indicator(s) to be used (the criteria applicable to these indicators, in terms of percentage/frequency/indicator species etc. are given in MacDonald <i>et al.</i> 1998- small-scale field indicators). N.B. not all indicators will be appropriate in all circumstances, e.g. geographic variation in community composition. The indicators are generally ordered with the most reliable indicators listed first.	Indicator of grazing, trampling, dunging or burning	Corresponding condition measures
			<ul style="list-style-type: none"> Growth-form and evidence of browsed shoots on <i>Myrica gale</i> bushes 	G	
			<ul style="list-style-type: none"> Uprooting of dwarf-shrub seedlings in recently burnt patches 	G	
			<ul style="list-style-type: none"> Stem breakage as a result of trampling by larger herbivores (check for hoof prints) 	G	
			<ul style="list-style-type: none"> Depth of carpet mosses and liverworts or "bushy" <i>Cladonia</i> lichens, under and between the dwarf-shrubs 	T	
			<ul style="list-style-type: none"> Amount of trampled, bare ground 	T	
			<ul style="list-style-type: none"> Amount of herbivore dung present 	D	
		Grazing impact trends	<ul style="list-style-type: none"> Growth-forms of <i>Calluna vulgaris</i> and/or <i>Vaccinium myrtillus</i> 	G	
			<ul style="list-style-type: none"> Changes in growth form recorded within the structure of dwarf-shrub bushes 	G	
			<ul style="list-style-type: none"> Height and cover of dwarf-shrubs relative to graminoids 	G	
		Herbivore species present	<ul style="list-style-type: none"> Record which herbivore species are present and whether impacts are clearly attributable to one or more species. 		

Indicators highlighted were those which were excluded or modified for this survey – see Section 2.1.

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