Stocking Rates of Land Capability for Agriculture Classes

Estimating the stocking rate characteristics of groupings of Macaulay Land Capability for Agriculture classes in the regions of Scotland

Keith Matthews, Dave Miller, Kevin Buchan

The James Hutton Institute

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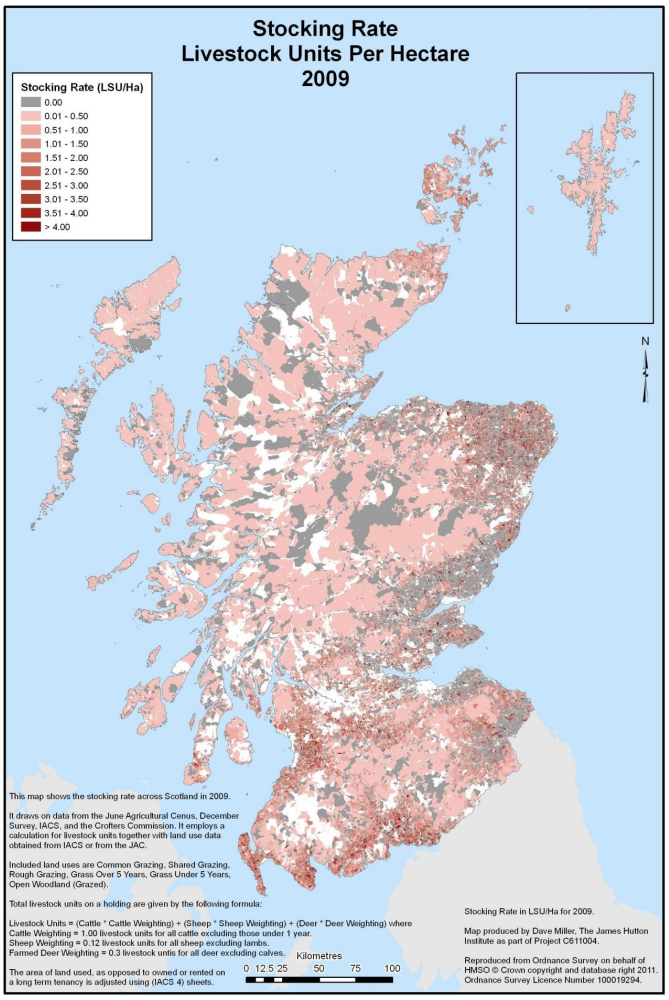
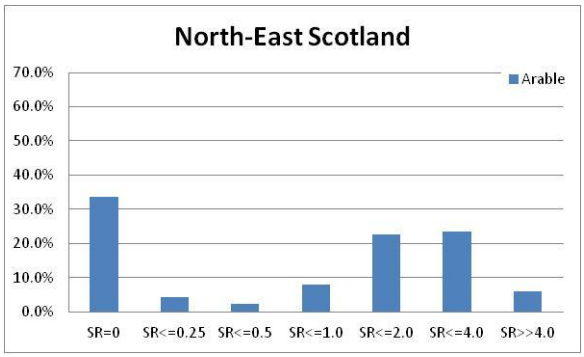


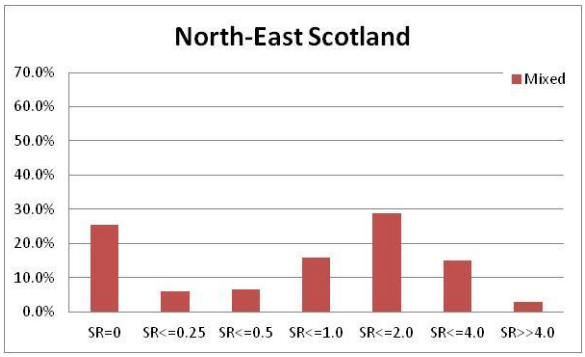
Contents

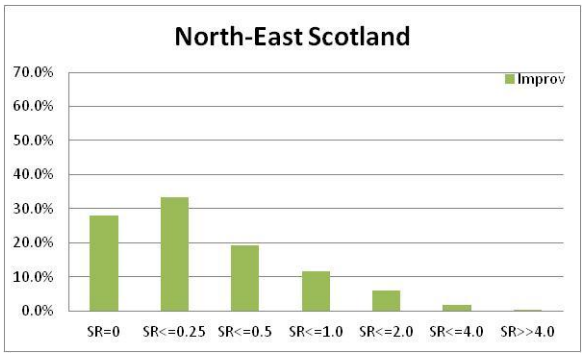
Executive Summary

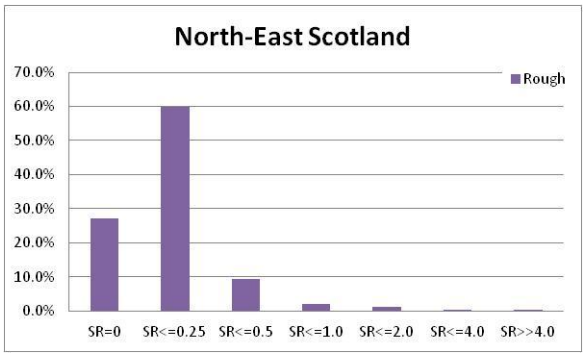
This document presents an analysis of the stocking rates, (SR, numbers of livestock units (LSU) per unit of area), associated with groupings of the Macaulay Land Capability for agriculture (LCA) classes for the Agricultural Regions (AgRegions) of Scotland. This analysis was sought to improve the evidence base used by RESAS to assist with, amongst other projects, the deliberations of the Woodland Expansion Advisory Group set up by Scottish Government in 2011.

The analysis combines potential for use as summarised by LCA with actual use as summarised by the SR's. These SR values are derived at field or holding level from Integrated Administration and Control System (IACS) and June Agricultural Census data (see Section 2 of the main report for details of data and methods). Recognising from previous analysis the spatial heterogeneity in SRs (see mapping in the main body of the report) the analysis preserves and quantifies the range and distribution of SR values associated with the combinations of AgRegion and LCA. This allows an appreciation of the uncertainty inherent in assessing the consequences for livestock numbers of any change in the woodland area for combinations of LCA and AgRegion. The figure below illustrates the information available at regional level using North-east Scotland as the example. Each graph shows the proportions of the forage area stocked at each SR rate for a grouping of LCA classes. Average values for the LCA-AgRegion combinations while informative, cannot alone adequately characterise the range of possible consequences. The supporting tabular data for all regions and LCA classes is presented in Section 6.3 of the main report.





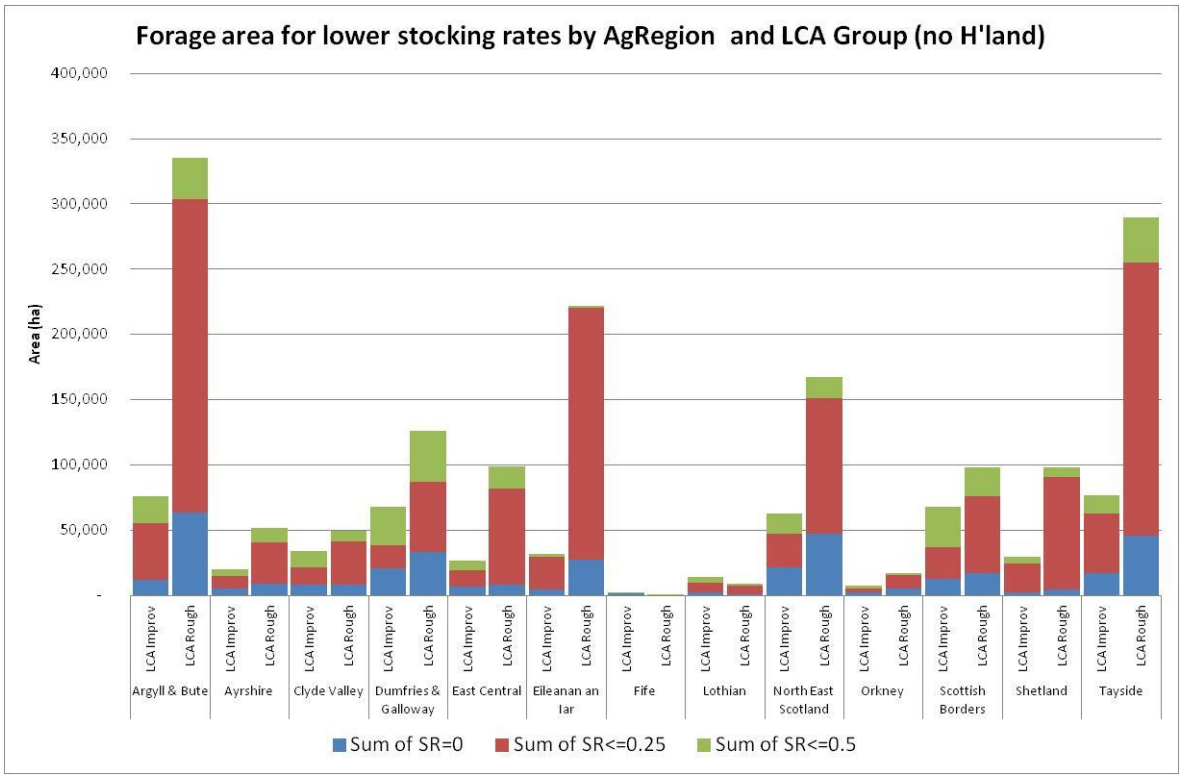




Accepting the caveat above, it is possible to generate robust area weighted averages for SR that provide an overview of the likely consequences for livestock numbers of changes to woodland areas on the combinations of LCA and AgRegion. The table below presents the cross-tabulation of average SR values for LCA and AgRegion. The table is colour coded to highlight combinations where SR is below 1.0 (in shades of purple) and above 1.0 in shades of green. As expected, SR declines across the LCA groups, from those classes with the highest potential (Arable) to the lowest (Rough). The key outcome, however, is in demonstrating value of regionalisation, since for the same LCA class there is a considerable range of SR values reflecting the other factors that determine SR beyond those biophysical characteristics expressed in LCA. A key caveat here is that treating Highland region as a single unit may be inadvisable since it is disproportionately large compared with the other AgRegions.

Weighted Average SR (lsu/ha)	**LCA Group**					
Region	**Arable**	**Mixed**	**Improv**	**Rough**	**Other**	**All LCA**
Argyll & Bute	1.76	0.68	0.29	0.14	0.23	0.21
Ayrshire	1.49	1.28	0.61	0.37	0.80	0.87
Clyde Valley	1.24	1.07	0.50	0.24	0.80	0.71
Dumfries & Galloway	1.95	1.41	0.77	0.34	0.97	0.86
East Central	1.60	0.80	0.32	0.16	0.63	0.38
Eileanan an Iar		0.18	0.14	0.09	0.08	0.09
Fife	1.23	1.20	1.22	0.97	0.75	1.19
Highland	0.80	0.54	0.14	0.08	0.10	0.13
Lothian	0.96	0.91	0.53	0.32	0.54	0.74
North East Scotland	1.70	1.20	0.37	0.14	0.59	0.76
Orkney		1.11	0.84	0.34	0.72	0.84
Scottish Borders	1.06	0.85	0.51	0.22	0.54	0.56
Shetland		0.25	0.22	0.17	0.21	0.18
Tayside	1.38	0.80	0.28	0.14	0.50	0.37
No Region	1.29	0.83	0.18	0.33	0.24	0.27
All Regions	**1.29**	**1.03**	**0.38**	**0.14**	**0.34**	**0.40**

The outputs from the analysis can also be summarised to provide indications of the areas of forage associated with SR values. This could be effective in highlighting where there may be opportunities for additional woodland on land with lower SR values. In this regard it is important to see that in nearly all regions there are substantial areas with SR's below 0.5 lsu/ha. The figure below illustrates these areas for the LCA Improved and Rough groupings. For clarity the figure omits Highland AgRegion since this has ~1.5m ha of LCA Rough with SR less than 0.5 lsu/ha. While Highland thus has by far the largest area other regions also have the potential to contribute to achieving increased areas of woodland.



A number of caveats and potential improvements to the analysis have become apparent during the course of the research (see Section 4 in the main report). None of these is sufficiently serious so as to undermine the validity of the results presented but some would merit further analysis. Further research is also required to determine how best to combine the SR values with other spatial datasets to allow assessment of within region patterns.

1. INTRODUCTION

This document presents an analysis of the stocking rates, (numbers of livestock units (LSU) per unit of area), associated with groupings of the Macaulay Land Capability for agriculture (LCA) classes for the Agricultural Regions (AgRegions) of Scotland. This analysis was sought to improve the evidence base used by RESAS to assist with, amongst other projects, the deliberations of the Woodland Expansion Advisory Group set up by Scottish Government in 2011.

The data sources, methods and assumptions inherent in the analysis are set out and results are presented, both as high level summaries (average stocking rates (SRs) per class) and more detailed distributional data. The document also highlights the issues that need to be considered when interpreting and using the high level results.

2. METHODS AND MATERIALS

The overall approach taken to the analysis is set out in outline in Figure 1. This can be summarised as four data integration and analytical steps:

- Define and map the potentially grazed forage area and attribute users;
- Derive stocking rates for the potentially grazed forage area;
- Derive the LCA mix for the potentially grazed forage area;
- Summarise the stocking rates present by groups of LCA class and administrative regions.

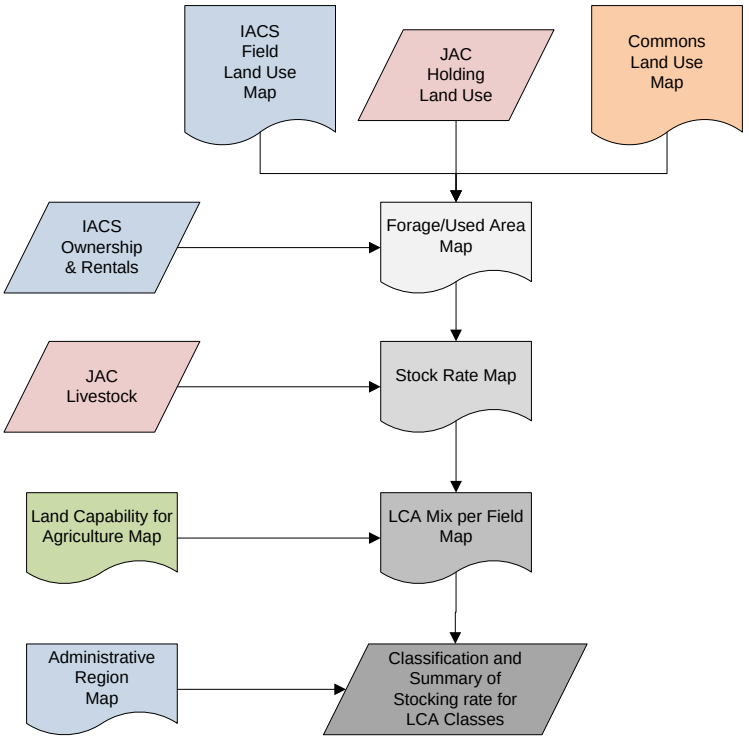


Figure 1

2.1. Datasets

2.1.1. Land Use and Land Users

Land use data is required to define the area of land potentially being used for forage. The land use data needs to be spatially explicit (mapped) so that the mix of LCA classes per field can later be derived by means of geographical information system (GIS) overlay.

The main land use dataset used was from the Integrated Administration and Control System (IACS) Single Application Form (SAF), with Permanent and Seasonal sheet data linked to GIS maps of land parcel boundaries (for May 2009). This is supplemented by data from the 2009 June Agricultural Census (JAC), the Shareholder Tenant (SHT) dataset in IACS, mapping of common grazings from Crofters Commission (March 2009) and common grazings identified in the IACS MP2 Address List (June 2009). 2009 data was used as this was immediately available and had been subjected to quality control previously. The area extents of the datasets are set out in Table 1. The table also lists those land uses included in the forage area with all others included in non-forage (mainly cropping and woodland).

Table 1: Coverage and forage land uses

Type	Area (ha)
All land	7,897,506
Mapped cover	6,306,084
Non mapped	1,591,422
Field - forage	4,346,598
Field – non-forage	814,938
Holding	579,544
Common	565,004

Forage Land Uses
Common Grazing
Rough Grazing
Grass Over 5 Years
Grass Under 5 Years
Open Woodland Grazed

The forage area was defined at field[i] level for all of the IACS-SAF area where land use data was present (~5.1M ha). Where mapping of land parcels was present but no 2009 land use was data available from SAF then land use was derived from JAC (~0.6M ha). The JAC land use data is not spatially explicit, that is the overall mix of land uses in a holding is known but the land uses of specific fields are not defined. For common grazings that do no appear in the IACS-SAF dataset (none are included in JAC) then a supplementary mapped dataset from the Crofters Commission was used with the assumption that all the common crazing area was made up of rough grazing land use (~0.6M ha). The three sources of data were stored in three map layers (Field, Holding and Commons) with rules used within the GIS to decide which had priority in setting values for a

[i] Field in this case refers to any land parcel defined in the GIS, clearly the nature of these varies from well defined lowland agricultural fields to unenclosed lands where fields relate to tenure.

particular field. Field, Commons[ii] and Holding was the order based on the level of detail provided by each dataset. Figure 2 shows the mapped forage area (from the three sources), the non-forage and the unmapped area.

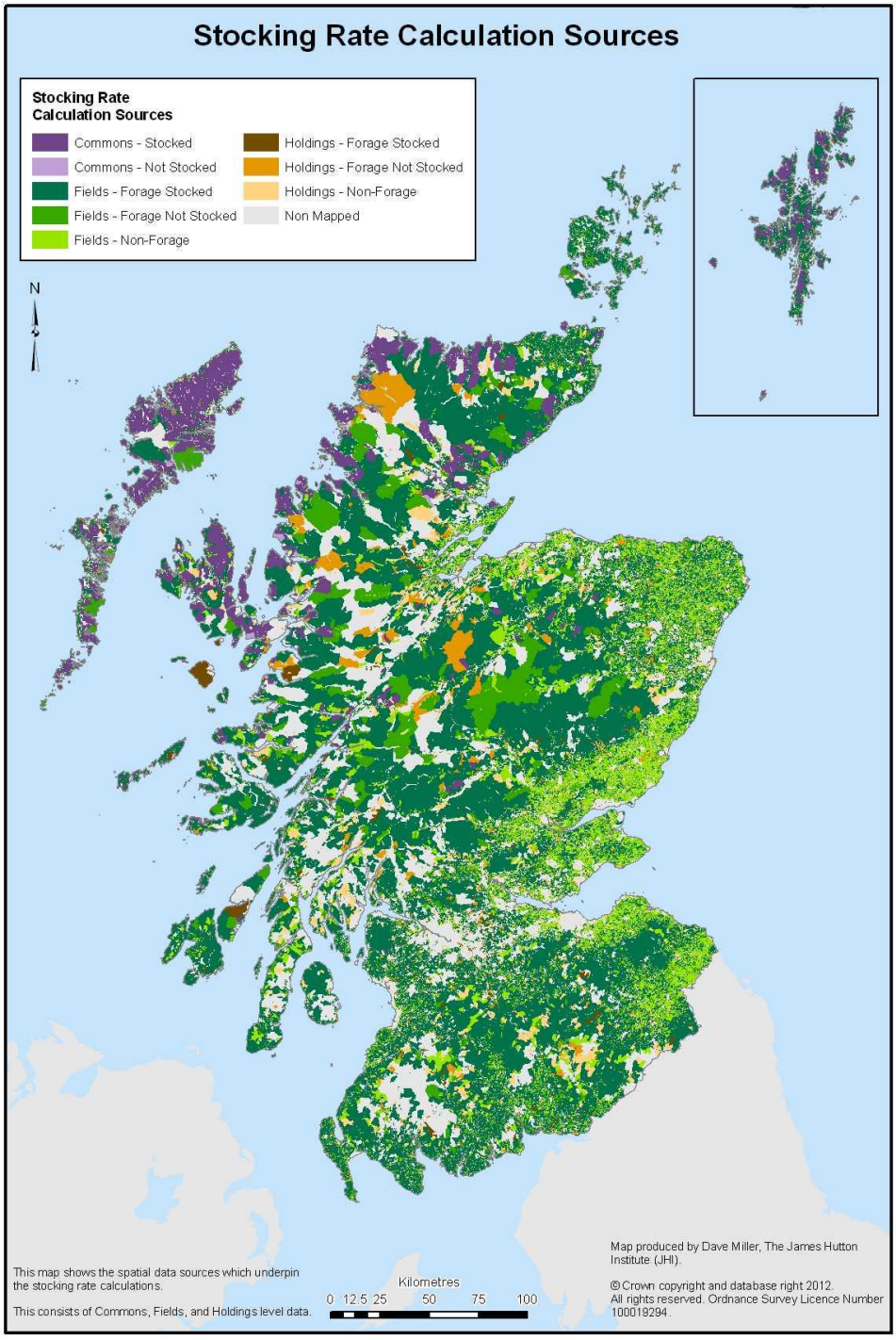


Figure 2

[ii] The commons layer is a composite of IACS GIS mapping of fields and Crofters Commission mapping of complete commons.

Note that since the primary purpose of the IACS-SAF dataset is the administration of agriculture related payments and policies the coverage is biased in favour of agricultural land used. In particular forestry is under-represented. This bias has no effect on the estimation of the SRs for the LCA groupings but it does mean that interpretation of associated areas or percentage of region figures does need to bear this in mind.

Since SR depends on the area of land being used by a holding rather than the area owned it is necessary to account for rentals of land. This was done using the IACS-SAF seasonal rentals sheet data (~700 thousand ha of mainly forage land). The attribution of rental use is known in 96% of cases for forage land and 90% of cropland. For JAC holdings, information on which specific parcel(s) are rented and the identity of the renter are not available so the assumption is made that all owned land is used. Where there is more than one holding using a single land parcel (commons and in some rentals) then the analysis tracks the shares for each holding and uses these as part of the SR calculations.

2.1.2. Livestock Numbers

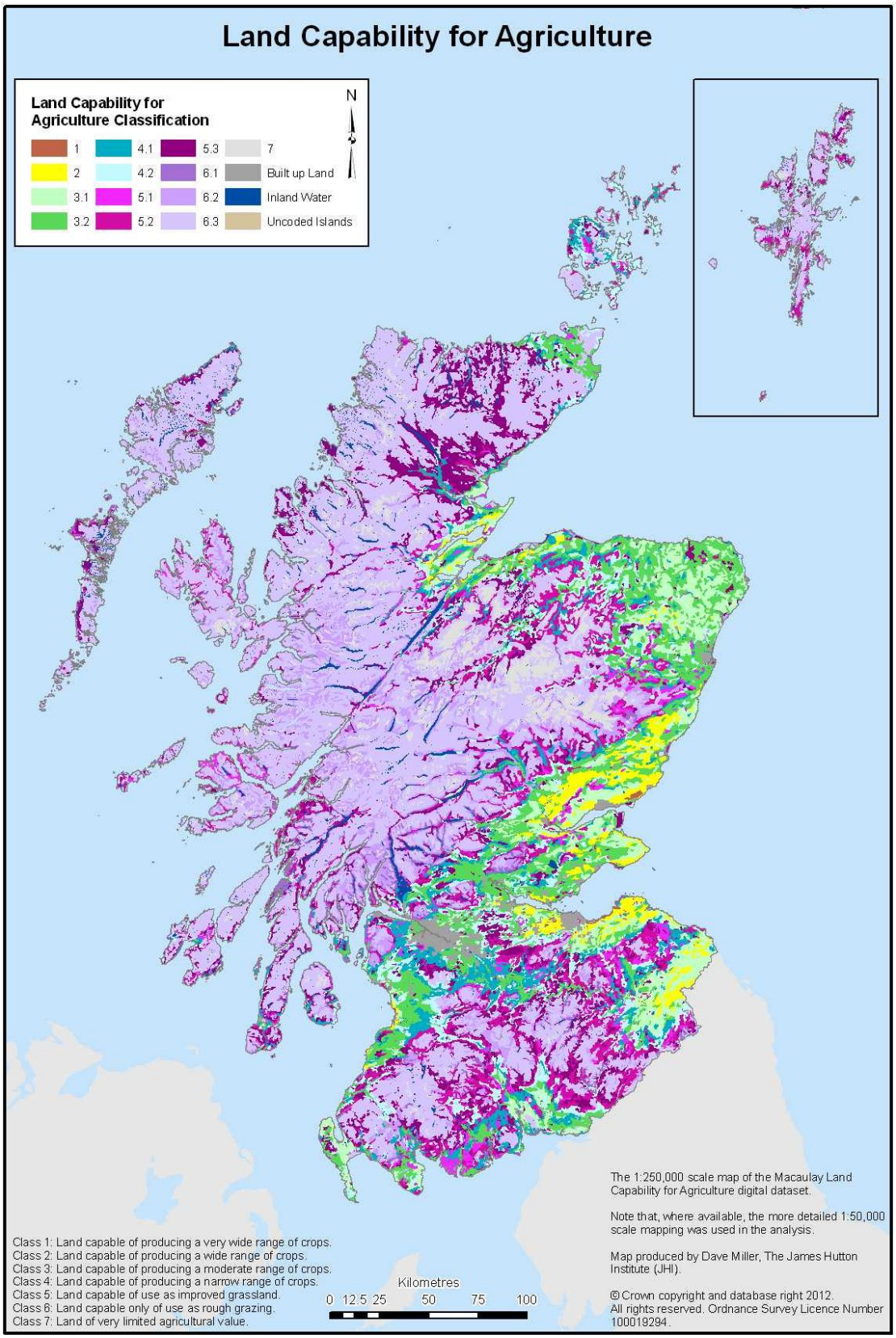
Livestock numbers and types are derived per holding from the JAC and December Survey (DS) both in 2009. The higher of these values is used so the SR's are the higher recorded value. Given the fluctuations in livestock numbers in response to differing management regimens there is clearly the need for some caution in the use of these livestock numbers. Whilst June would typically see the highest rates of stocking, it is possible that neither of the June nor December dates reflects the maximum stocking. Conversely it may be that the recorded values reflect a peak value for livestock numbers not typical for the holding at other times. Within the land use dataset there are also significant areas of "forage" recorded within holdings who own no stock (at June or December). In this case the land may be being used for other purposes, used informally or used seasonally for only short periods of time, for example of finishing. Livestock may also not be captured by JAC or DS if they are always kept on seasonal lets and the keeper/owner has no other permanent land (rented or owned). In these latter cases the stocking rate may be underestimated. Accepting these caveats the JAC and DS livestock numbers are, however, the most reliable and comprehensive available source for this information at present[iii]

[iii] Options for using the British Cattle Movement Service dataset for statistical purposes are being explored SG.

2.1.3. Land Capability for Agriculture Classification

The Macaulay LCA classification was first published in 1982. The classification ranks land on the basis of its potential productivity and cropping flexibility determined by the extent to which its physical characteristics (soil, climate and relief) impose long-term restrictions on its agricultural use. There are seven classes, Class 1 offering the highest potential flexibility of agricultural use and Class 7 land being of very limited agricultural value (see Figure 3). Classes 1-4 comprise land suited to arable cropping, with decreasing opportunities for arable crops from Class 1 to Class 4. Class 4 land is land suited primarily for grassland with only short arable breaks. Class 5 land is capable of use as improved grassland with very limited opportunities for the occasional pioneer crop. Class 6 land is capable only of use as rough grazing with no realistic potential for improvement. Classes 3 and 4 are subdivided into two divisions and Classes 5 and 6 into three divisions (again see Figure 3). These classes and subdivisions can usefully be grouped as follows. Land capable of supporting Arable Agriculture – classes 1 to 3.1. Land Capable of supporting Mixed Agriculture – classes 3.2 to 4.2. Land capable of supporting Improved Grassland – classes 5.1 to 5.3. Land capable of supporting only Rough Grazing- classes 6.1 to 7. These are the LCA class groupings for which stocking rates have been derived. A further LCA grouping is also present – LCA Other. This grouping includes built-up areas, inland water, and islets too small to be included in the mapping of the LCA. Differences in the dates and scales of mapping mean that in some cases areas of forage occur on land mapped as LCA Other. To ensure consistency of regional totals and so as not to exclude areas of forage and livestock, LCA Other has also been included in the tabular outputs.

The map in Figure 3 shows the 1:250,000 scale LCA dataset. It should be noted that a "hybrid" dataset combining 1:250,000 scale mapping and 1:50,000 scale mapping was used in this analysis. The 1:50,000 scale mapping provides a finer resolution of conditions in those regions with more intensive management regimens.


Land Capability for Agriculture
Land Capability for Agriculture Classification
1
2
3.1
3.2
4.1
4.2
5.1
5.2
5.3
6.1
6.2
6.3
7
Built up Land
Inland Water
Uncoded Islands
N
Kilometres
0 12.5 25 50 75 100
The 1:250,000 scale map of the Macaulay Land Capability for Agriculture digital dataset.
Note that, where available, the more detailed 1:50,000 scale mapping was used in the analysis.
Map produced by Dave Miller, The James Hutton Institute (JHI).
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Class 1: Land capable of producing a very wide range of crops.
Class 2: Land capable of producing a wide range of crops.
Class 3: Land capable of producing a moderate range of crops.
Class 4: Land capable of producing a narrow range of crops.
Class 5: Land capable of use as improved grassland.
Class 6: Land capable only of use as rough grazing.
Class 7: Land of very limited agricultural value.

Figure 3

2.2. Analyses

2.2.1. Forage area per holding

The total area for each holding is calculated as owned area plus any share of commons area plus rented-in area minus rented out area. Common grazings with no known shareholders are treated as individual holdings. To enforce data integrity the IACS field data claims, and in particular the seasonal rental claims, are adjusted using an improved version of the multi-step process described in previous work. Despite this in some cases the rented-in area does not match the rented-out area therefore some uncertainty is introduced.

The forage area per holding is defined based on land use using the same assumptions as have been used for the research in support of the Pack Inquiry and in defining the potential new recipients of SFP for SG. The principal exclusions are cropped land and forestry. For a full list of exclusions see the Pack Inquiry report[iv].

2.2.2. Stocking rates

Stocking rate is simply the ratio of livestock numbers (expressed as standard livestock units) to available forage area. The livestock units were derived as follows

Livestock Units = (Cattle * Cattle Weighting) + (Sheep * Sheep Weighting) + (Deer * Deer Weighting) where:

Cattle weighting = 1.00 livestock units for all cattle excluding those under 1 year,

Sheep Weighting = 0.12 livestock units for all sheep excluding lambs,

Farmed Deer Weighting = 0.3 livestock units for all deer excluding calves.

These are standard weightings for cow-calf, sheep-lamb, and deer-calf combinations and are adequate for the purposes of this analysis. Previous analysis has shown the greater sensitivity of SR results to the parameterisation of the sheep weighting.

This calculation provides an average stocking rate for the land used by the holding. All forage land parcels used by the holding are assigned this value. Where significantly different enterprises exist within a holding, e.g. dairy cattle and hill sheep, then the holding average is characteristic of the

[iv] http://www.scotland.gov.uk/Publications/2010/11/01153620/0

holding as a whole, but of neither livestock system in particular, nor would it be representative of particular land parcels. Since no land management information is available indicating which stock use particular land parcels any differentiation within holdings would depend on making further assumptions.

Where there are multiple users of a single land parcel the stocking rate for the parcel is derived as the ratio of the sum of the livestock units from each share[v] to the area of all shares.

Where no field mapping is present it is possible to derive stocking rates for holdings using JAC data but it is not possible to derive an LCA mix. Such holdings cannot therefore be included in the LCA-SR analysis.

Figure 4 shows a national level map of SRs. Note that the grey areas with zero SR contain both non-forage land uses and land with forage land use but no stock present. The latter include areas of "improved" grasslands[vi] (49,824 Ha of grass under five years and 92,533 Ha of grass over five years). These are likely being maintained for agricultural purposes but since there are no livestock associated with the holding in JAC or DS they have a zero SR. Also note the heterogeneity of SRs within small areas and the concentration of higher SRs in particular regions (for example Northeast Scotland and Dumfries and Galloway) though pockets of higher SRs appear in most regions.

[v] LSU on the share = SR of the holding using the land *area of share

[vi] IACS land uses temporary and permanent grasslands (TGRS and PGRS).

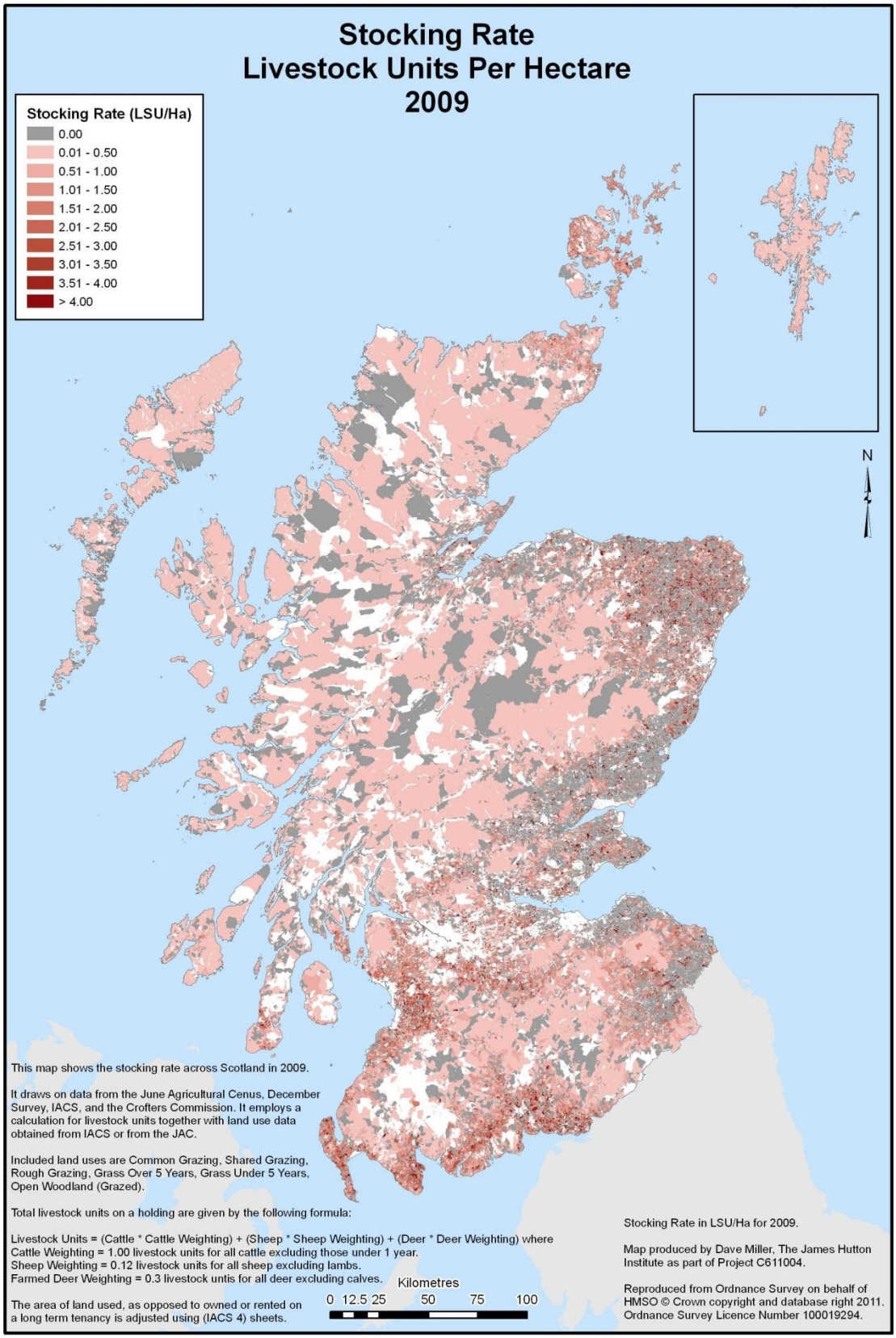
Stocking Rate
Livestock Units Per Hectare
2009
Stocking Rate (LSU/Ha)
0.00
0.01 - 0.50
0.51 - 1.00
1.01 - 1.50
1.51 - 2.00
2.01 - 2.50
2.51 - 3.00
3.01 - 3.50
3.51 - 4.00
> 4.00
N
This map shows the stocking rate across Scotland in 2009.
It draws on data from the June Agricultural Cenus, December Survey, IACS, and the Crofters Commission. It employs a calculation for livestock units together with land use data obtained from IACS or from the JAC.
Included land uses are Common Grazing, Shared Grazing, Rough Grazing, Grass Over 5 Years, Grass Under 5 Years, Open Woodland (Grazed).
Total livestock units on a holding are given by the following formula:
Livestock Units = (Cattle * Cattle Weighting) + (Sheep * Sheep Weighting) + (Deer * Deer Weighting) where
Cattle Weighting = 1.00 livestock units for all cattle excluding those under 1 year.
Sheep Weighting = 0.12 livestock units for all sheep excluding lambs.
Farmed Deer Weighting = 0.3 livestock untis for all deer excluding calves.
The area of land used, as opposed to owned or rented on a long term tenancy is adjusted using (IACS 4) sheets.
Kilometres
0 12.5 25 50 75 100
Stocking Rate in LSU/Ha for 2009.
Map produced by Dave Miller, The James Hutton Institute as part of Project C611004.
Reproduced from Ordnance Survey on behalf of HMSO © Crown copyright and database right 2011. Ordnance Survey Licence Number 100019294.

Figure 4

2.2.3. LCA mix per field

The LCA mix for those land parcels identified in the IACS-SAF GIS mapping is derived by overlaying[vii] the stocking rate maps (Field-Commons-Holding) with the LCA in a GIS. The output of this operation is a map with individual records as follows

ID	Source			Area	Stocking Rate	LCA Code	LCA Group
	Field	Holding	Commons				
number	flag	flag	flag	ha	LSU/ha	number	category

Source identifies the dataset from which land use and stocking rate data have come, area and stocking rate values are self-explanatory, the LCA code is a look up to the LCA classes, subdivisions or classes where LCA has not been determined (e.g. built up areas), LCA group is the higher level grouping set out previously.

An individual record will be for a whole field unless the field has more than one LCA class in which case more than one record will be generated.

2.2.4. Regional identifiers

Given the objective of summarising the SR for groups of LCA classes at regional level it was necessary to add regional identifiers to the land parcels. Whilst this could have been done for those holdings in JAC from the existing regional classification within the JAC dataset, it was decided in this case to use a further GIS overlay with a map of the NUTS4 regions. This was done so that in all cases the land parcels (or parts thereof) were allocated to the correct region. In the JAC dataset the holding is allocated to the correct region based on the location of the steading but not all of the land parcels would be correctly allocated to regions in large holdings or holdings that straddle regional boundaries. In any case this would have been required for those mapped elements not within the JAC. NUTS4 was chosen as the smallest standardised regional division as higher level aggregations can be built from this, i.e. NUTS3 and 2 and AgRegions used in this analysis.

This overlay operation adds a regional identifier to all the records falling within a single region and generates two or more new records when a regional boundary is straddled. Figure 5 shows the AgRegions map used as the basis for regional summaries in the analysis.

[vii] The specific overlay was a union.

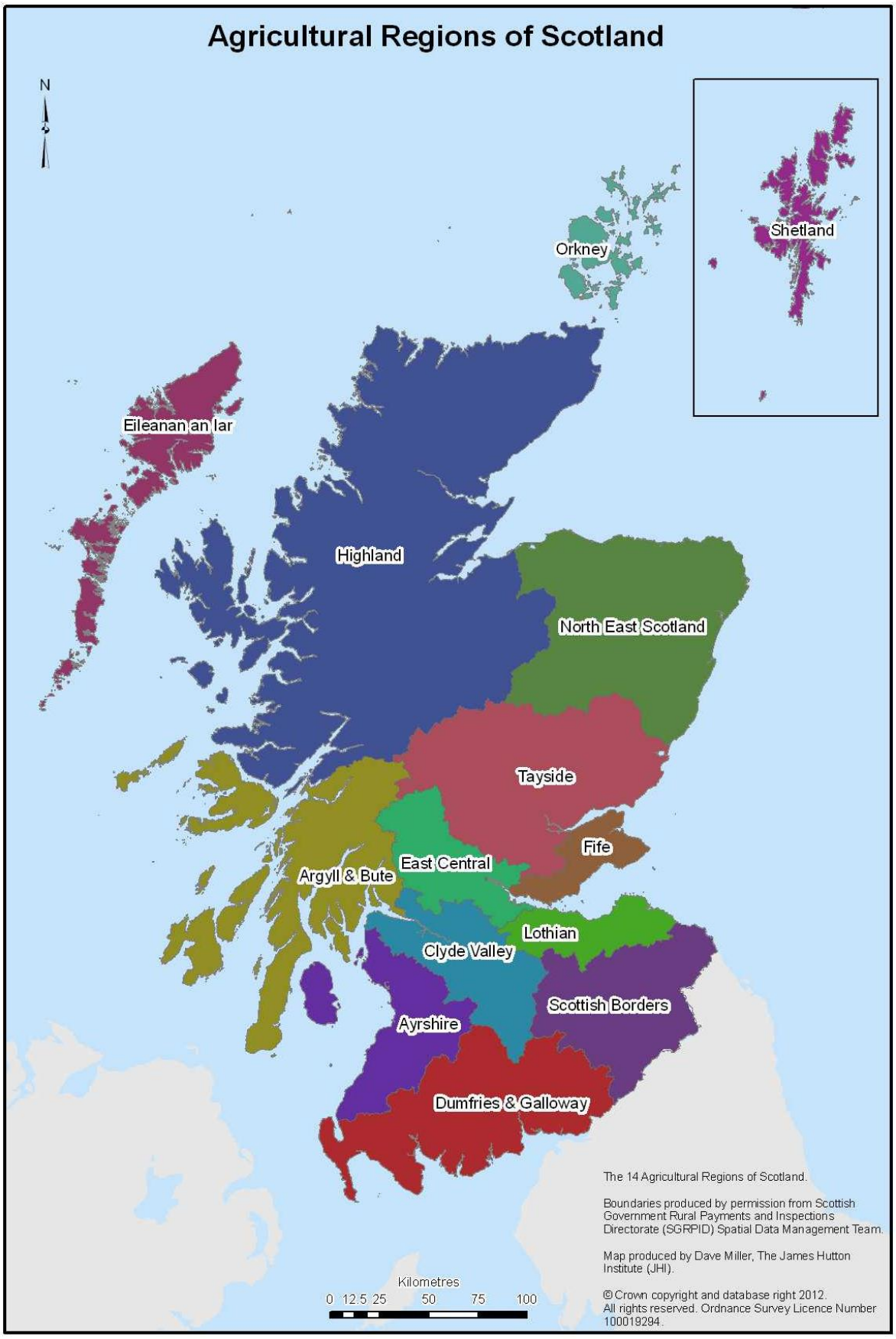
Agricultural Regions of Scotland
N
Shetland
Orkney
Eileanan an Iar
Highland
North East Scotland
Tayside
Fife
East Central
Argyll & Bute
Lothian
Clyde Valley
Scottish Borders
Ayrshire
Dumfries & Galloway
Kilometres
0 12.5 25 50 75 100
The 14 Agricultural Regions of Scotland.
Boundaries produced by permission from Scottish Government Rural Payments and Inspections Directorate (SGRPID) Spatial Data Management Team.
Map produced by Dave Miller, The James Hutton Institute (JHI).
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Figure 5

2.2.5. Deriving a tabular dataset

To support summarising and presenting the dataset, the records generated in the GIS were imported in an ORACLE database for further processing. Within the database the individual records are classified based on stocking rate to generate a dataset that supports presenting distributions of stocking rate values for combinations of LCA classes and/or regions. This "binning" process used the following threshold values.

Table 2: SR classification thresholds

Threshold (LSU/ha)	Rationale
0	Forage land that is not stocked with cattle, sheep or deer. For higher LCA classes (6+) much of this will be land designated as rough grazing but used for other purposes such as hunting. For lower LCA classes this land may be grass breaks or headlands or grass used seasonally but for which no owned livestock records are available. If non-forage land were included in estimations of average SR for LCA classes then such fields would also have zero SR (e.g. cropland and woodland).
0.25	~2 sheep per ha
0.5	~4 sheep per ha
1.0	1 cow-calf unit per ha
2.0	2 cow-calf units per ha
4.0	4 cow-calf units per ha
More than 4.0	Within this class there are legitimate SR values, for example where businesses have housed livestock, there are however also a small number of holdings with SRs over ten and while these may reflect housed livestock using bought in feed they may also reflect remaining problems in the attribution of seasonal forage land to users.

These bin values double the stocking rate for each class from 0.25 lsu/ha onwards. This structure was chosen since it provides finer differentiation in the lower stocking rates (the areas of greater interest to the WEAG) while still limiting the number of categories such that the tabular and graphical presentations remain clearly interpretable.

3. RESULTS

3.1. Area Weighted Average Stocking Rates

To provide a summary SR value for each AgRegion and LCA combinations, an area weighted average of SRs has been calculated. This calculation has maintained the SR bins for as long as possible within the calculation so as to make explicit the range and distribution of SR values associated with the LCA classes. This can be significant even within a single region (see Figure 6 for a graphical example for Northeast Scotland). The area of the forage and the average SR for each AgRegion-LCA combination is tabulated for each of the SR bins in Section 6.3. This would allow for the inclusion of uncertainty in assessing the consequences for livestock numbers for any increase in woodland area, defining the largest or smallest numbers of livestock that may be displaced.

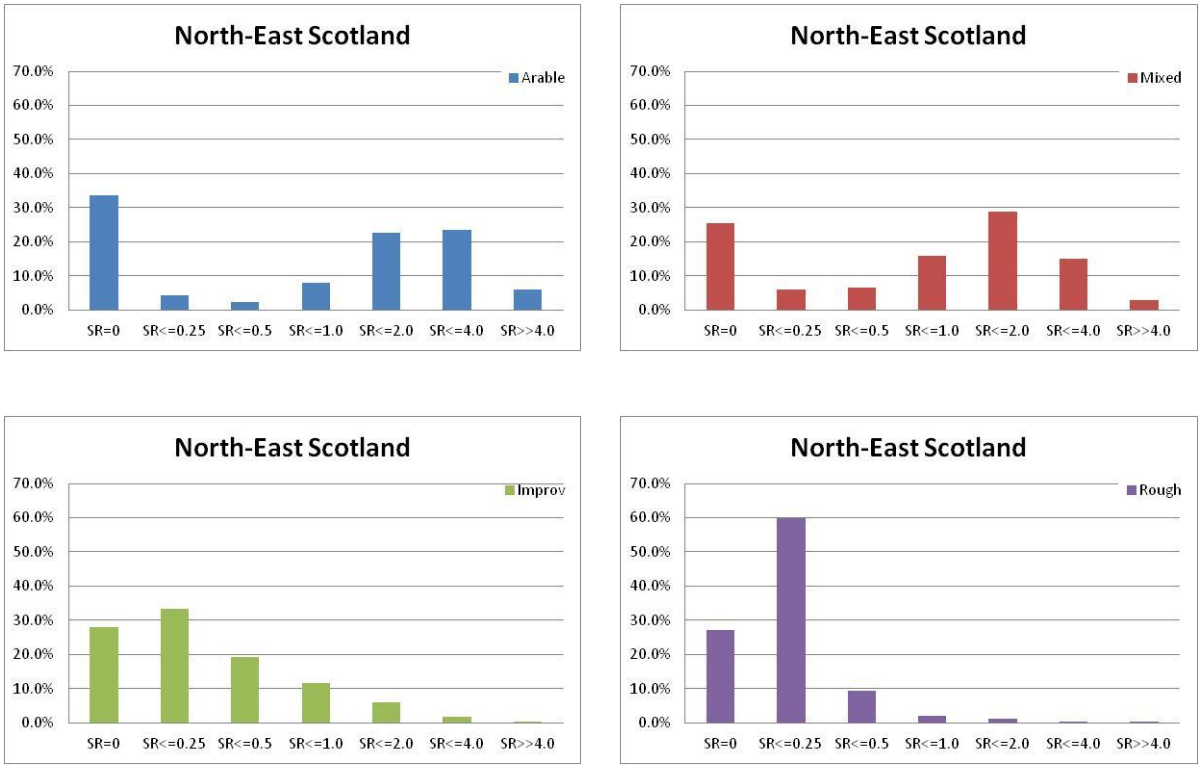

Figure 6

Table 3 presents the area weighted average stocking rates for each of the LCA groupings cross tabulated by AgRegion. The colours highlight where SRs are less than 1.0 lsu/ha in deepening shades of purple and above 1.0 lsu/ha in shades of green. The consistent trend is for higher stocking rates on the better quality land but with a wide range of variability between regions for the same LCA group. This variability emphasises that it is necessary to assess the relationship between SR and LCA at regional scale if the implications for any change in land use are to be assessed.

Table 3: Area weighted average stocking densities for forage land

Weighted Average SR (lsu/ha)	LCA Group					
Region	**Arable**	**Mixed**	**Improv**	**Rough**	**Other**	**All LCA**
Argyll & Bute	1.76	0.68	0.29	0.14	0.23	0.21
Ayrshire	1.49	1.28	0.61	0.37	0.80	0.87
Clyde Valley	1.24	1.07	0.50	0.24	0.80	0.71
Dumfries & Galloway	1.95	1.41	0.77	0.34	0.97	0.86
East Central	1.60	0.80	0.32	0.16	0.63	0.38
Eileanan an Iar		0.18	0.14	0.09	0.08	0.09
Fife	1.23	1.20	1.22	0.97	0.75	1.19
Highland	0.80	0.54	0.14	0.08	0.10	0.13
Lothian	0.96	0.91	0.53	0.32	0.54	0.74
North East Scotland	1.70	1.20	0.37	0.14	0.59	0.76
Orkney		1.11	0.84	0.34	0.72	0.84
Scottish Borders	1.06	0.85	0.51	0.22	0.54	0.56
Shetland		0.25	0.22	0.17	0.21	0.18
Tayside	1.38	0.80	0.28	0.14	0.50	0.37
No Region	1.29	0.83	0.18	0.33	0.24	0.27
All Regions	**1.29**	**1.03**	**0.38**	**0.14**	**0.34**	**0.40**

3.2. Stocking Rate Mix per Region

The average SR for the combinations of LCA grouping versus AgRegion depends on the mix of SRs and their associated areas. For example Lothian and Northeast Scotland have similar overall SRs (0.74 and 0.76) but their mix of SRs and LCA are quite distinct. The figures below illustrate the mix of SRs that occur in each region. The first three figures (6 to 8) present the overall mix of SRs present in the region regardless of LCA grouping. Figure 7 presents the forage area for each of the SR bins for each region, with Figure 8 presenting the same data but omitting Highland region for clarity. Figure 9 presents the data as the share of each SR bin of the forage area. These figures serve to highlight where there is apparently unstocked forage land (mid blue) and where there are areas of lower (though likely appropriate) stocking rates (red).

These SR mixes are further broken down by LCA class in Figure 10 and Figure 11 which show the SR mix, in terms of the forage area per SR bin, for each of the LCA groups present (Figure 11 again omits Highland region for clarity). Figure 12 highlights that while in most cases it is only on the LCA Rough land that SRs fall below 0.5 lsu/ha for substantial areas, there are areas of such stocking on better quality land in nearly all regions. The figure also highlights that in all regions there are areas with lower stocking rates where increased areas of woodland would have more limited effects on livestock numbers.

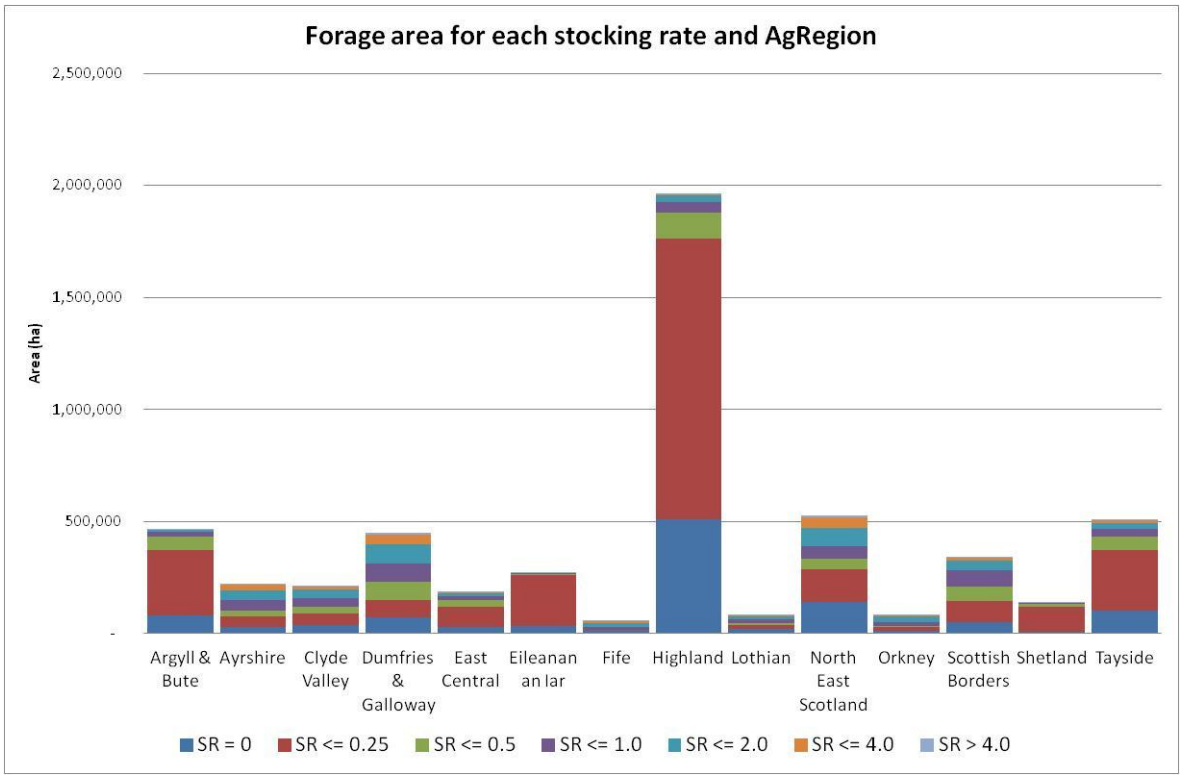

Figure 7

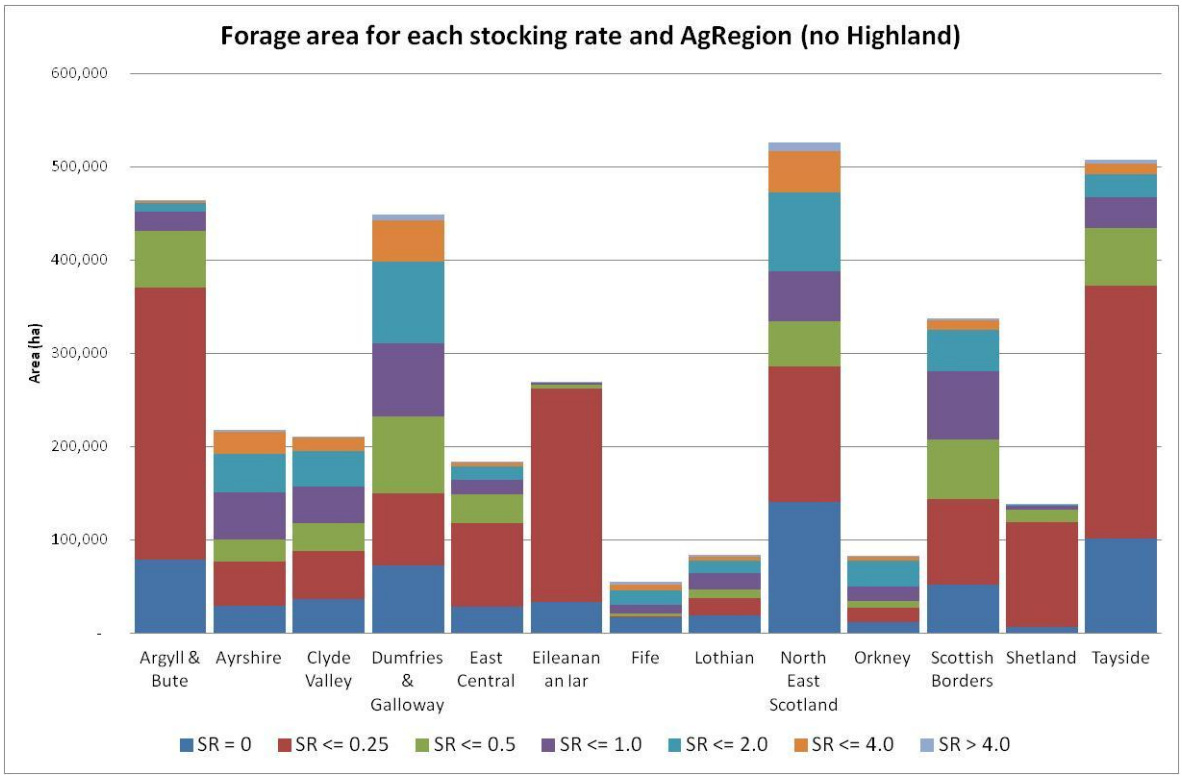

Figure 8

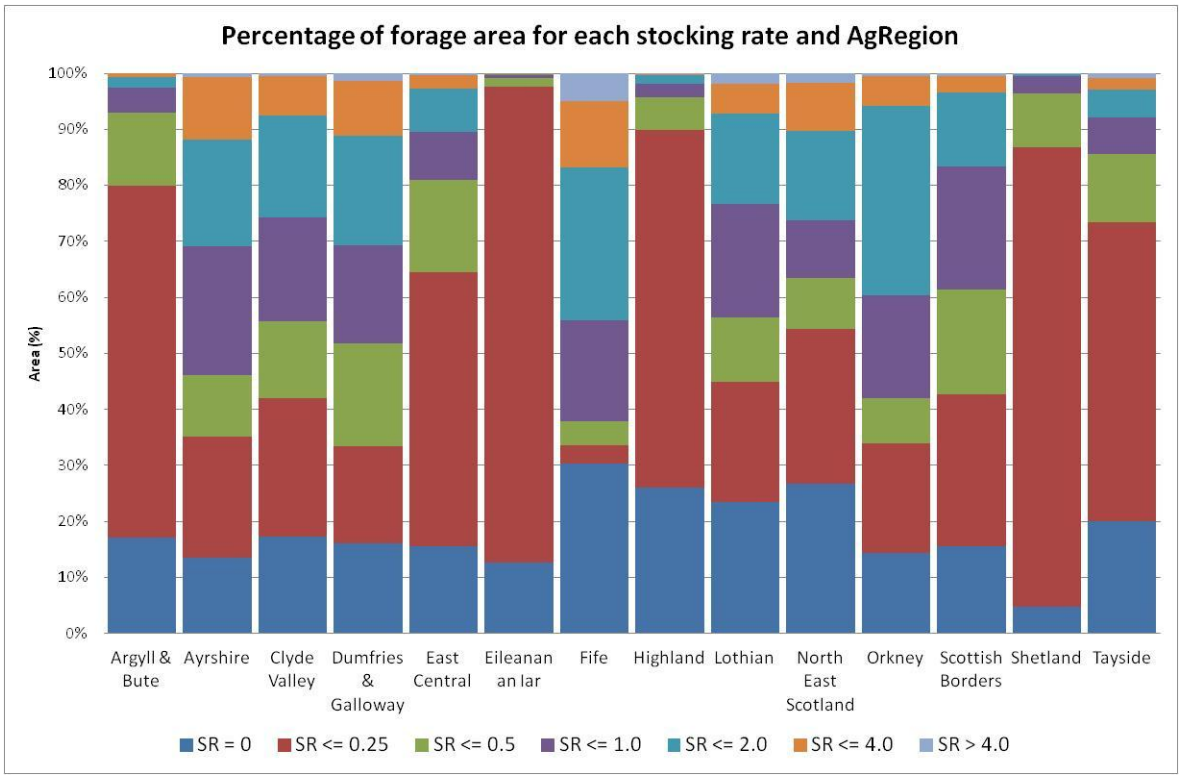
Percentage of forage area for each stocking rate and AgRegion
Area (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Argyll & Bute
Ayrshire
Clyde Valley
Dumfries & Galloway
East Central
Eileanan an Iar
Fife
Highland
Lothian
North East Scotland
Orkney
Scottish Borders
Shetland
Tayside
SR = 0
SR <= 0.25
SR <= 0.5
SR <= 1.0
SR <= 2.0
SR <= 4.0
SR > 4.0

Figure 9

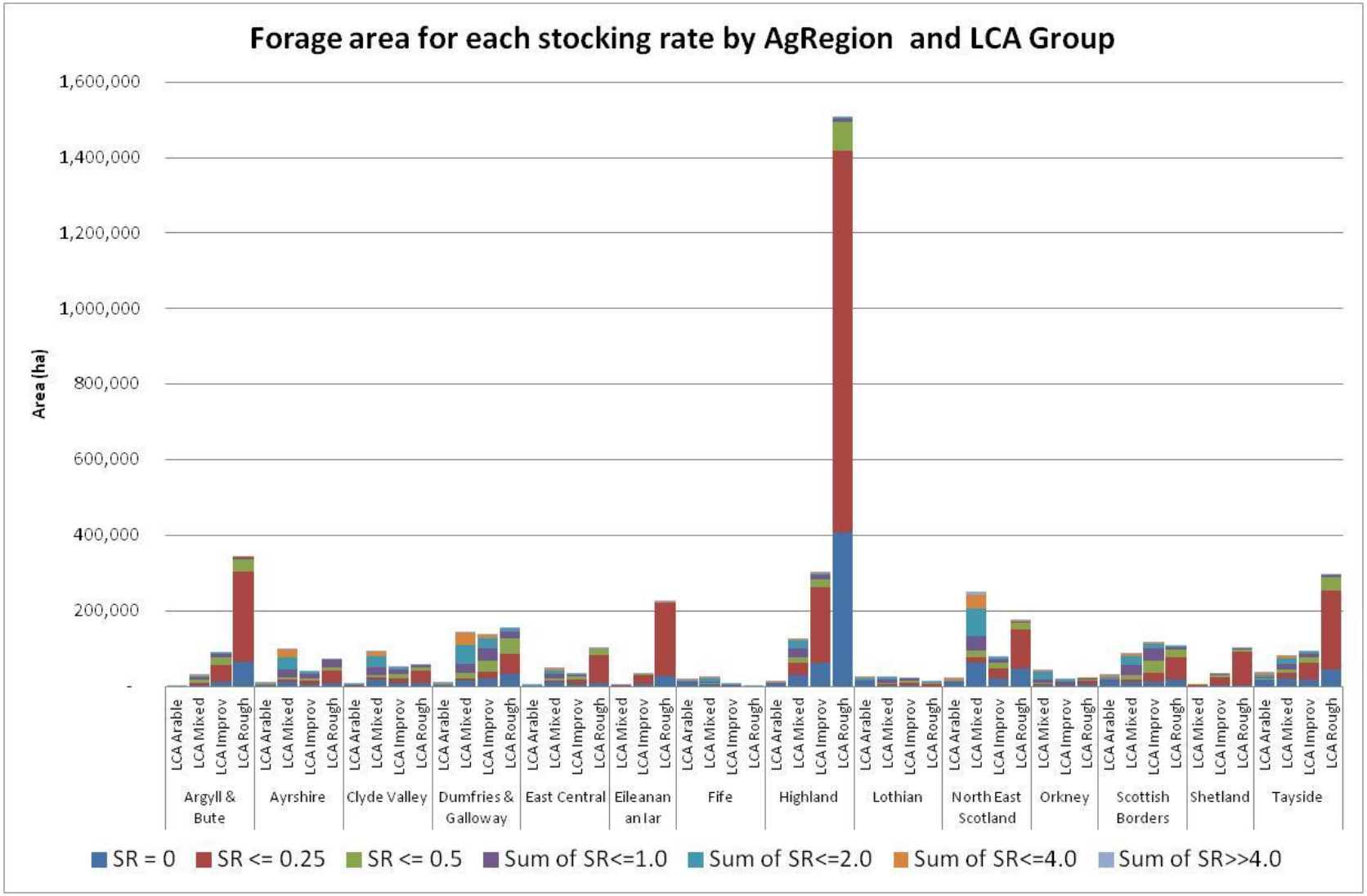
Forage area for each stocking rate by AgRegion and LCA Group
Area (ha)
1,600,000
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
-
LCA Arable
LCA Mixed
LCA Improv
LCA Rough
Argyll & Bute
Ayrshire
Clyde Valley
Dumfries & Galloway
East Central
Eileanan an Iar
Fife
Highland
Lothian
North East Scotland
Orkney
Scottish Borders
Shetland
Tayside
SR = 0
SR <= 0.25
SR <= 0.5
Sum of SR<=1.0
Sum of SR<=2.0
Sum of SR<=4.0
Sum of SR>>4.0

Figure 10

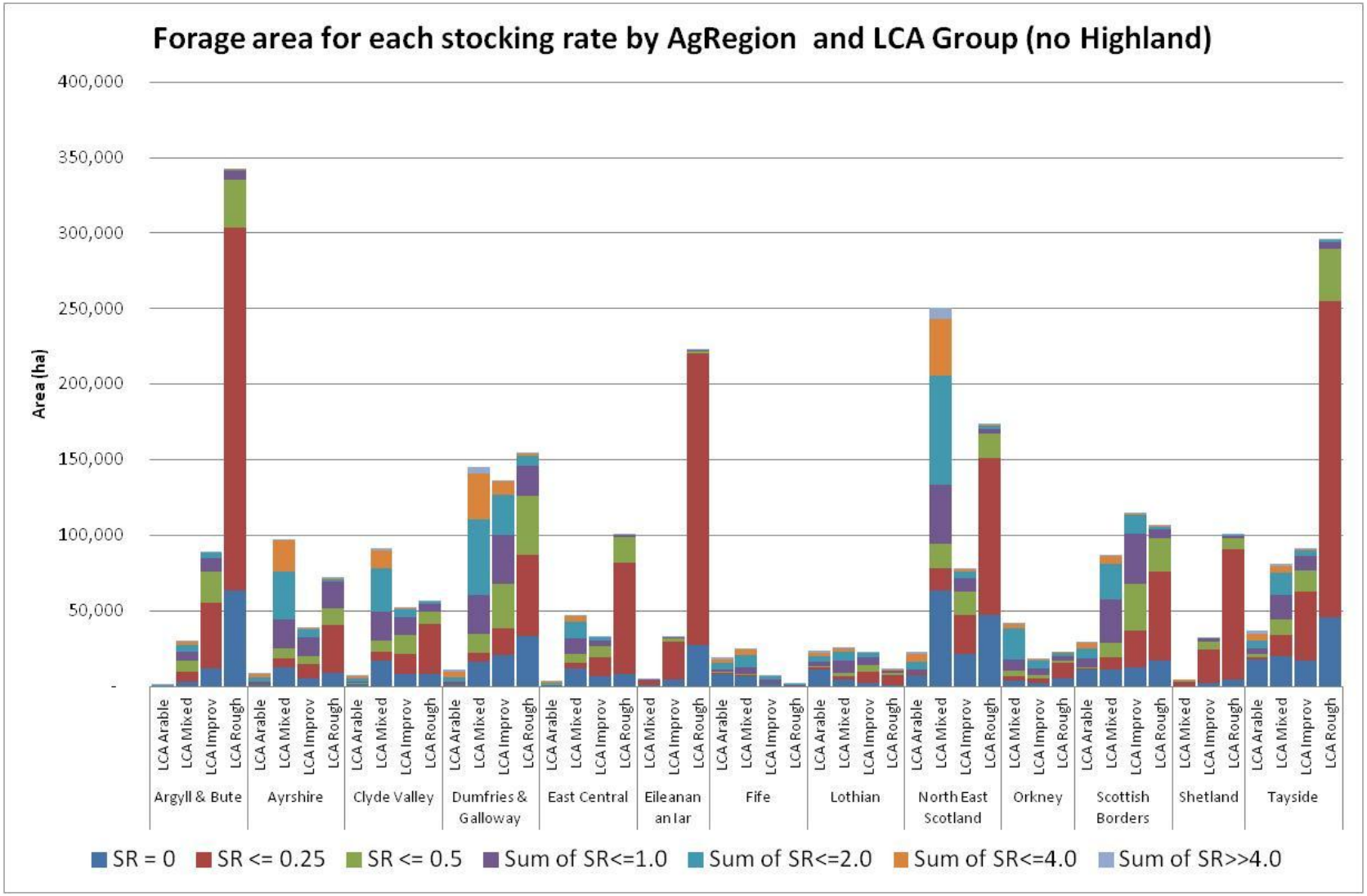
Forage area for each stocking rate by AgRegion and LCA Group (no Highland)
Area (ha)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
LCA Arable
LCA Mixed
LCA Improv
LCA Rough
Argyll & Bute
Ayrshire
Clyde Valley
Dumfries & Galloway
East Central
Eileanan an Iar
Fife
Lothian
North East Scotland
Orkney
Scottish Borders
Shetland
Tayside
SR = 0
SR <= 0.25
SR <= 0.5
Sum of SR<=1.0
Sum of SR<=2.0
Sum of SR<=4.0
Sum of SR>>4.0

Figure 11

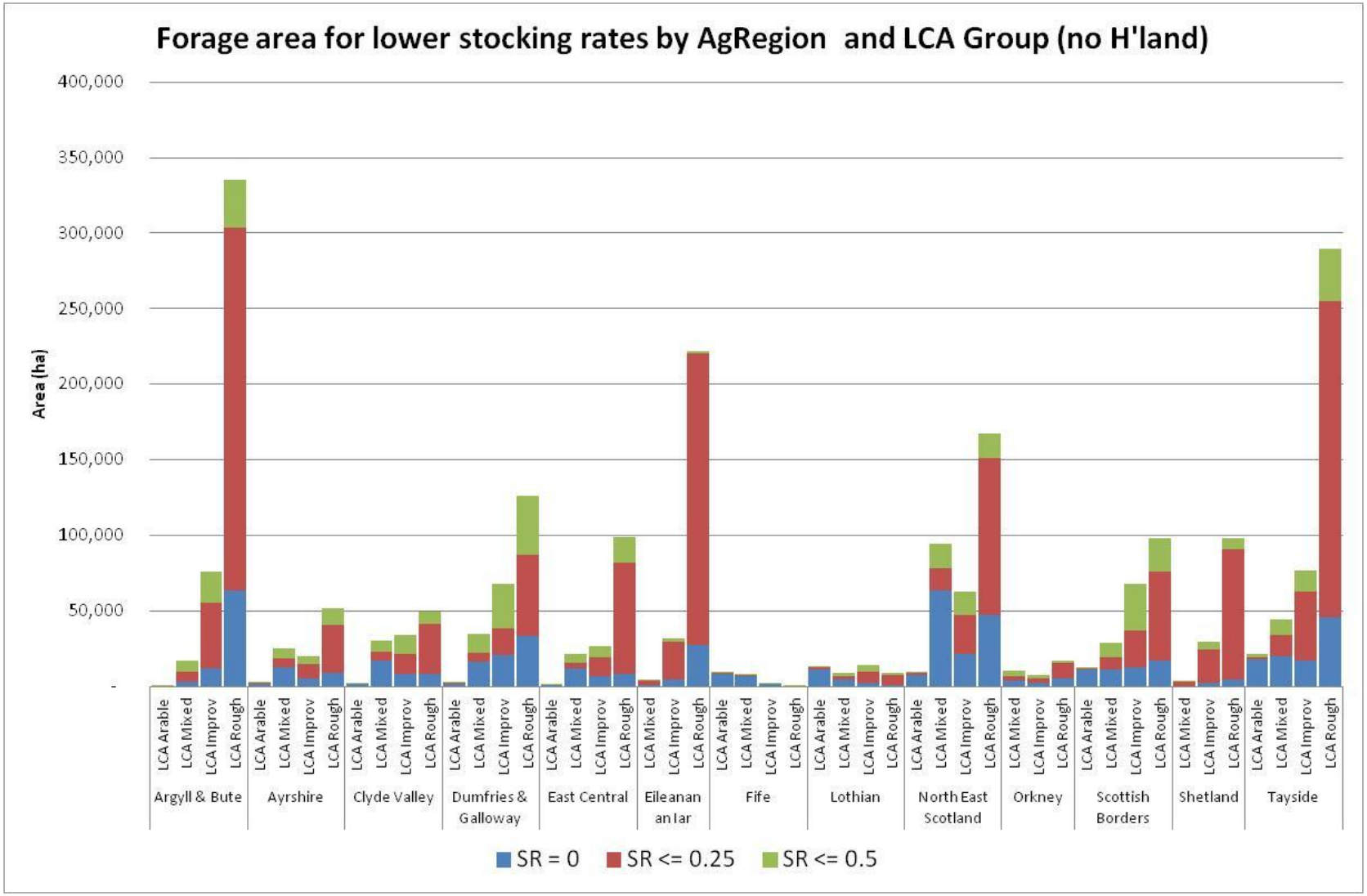
Forage area for lower stocking rates by AgRegion and LCA Group (no H'land)
Area (ha)
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
LCA Arable
LCA Mixed
LCA Improv
LCA Rough
Argyll & Bute
Ayrshire
Clyde Valley
Dumfries & Galloway
East Central
Eileanan an Iar
Fife
Lothian
North East Scotland
Orkney
Scottish Borders
Shetland
Tayside
SR = 0
SR <= 0.25
SR <= 0.5

Figure 12

4. CAVEATS TO THE ANALYSIS AND RESULTS

The two main limitations to the estimation of the SR values are:

1. The need to use the non-spatially explicit JAC data as the source of land use (9% of mapped area). While the SR's are calculated correctly based on the JAC data, the SR is mapped across all the fields that make up the holding rather than only those making up the forage area. Note this affects only the representation of the SRs as maps not the tabular data totals. In most cases this "increased" area will not be significant as the affected holdings do not have large areas of cropping or woodland (the main excluded classes).
2. For the Mapped Commons areas (565,004 ha) assumptions have had to be made on the nature of the land use (defaulting to inclusion). In some of these areas the SR may be underestimated by including non-forage areas such as bracken, scrub and bare rock. Given the generally low rates of stocking associated with commons, however, it is unlikely that this has changed the SRs significantly. Use of other datasets may improve the representation of the land use within the mapped commons areas but was beyond the scope of this analysis.
3. The assumption that the holding level SR applies to all forage fields, while acceptable for a national scale analysis and an improvement on the use of parish level SRs, has been noted previously as a limitation. Options exist for differentiating within holdings but this would require further analysis.

In considering the further use of the average stocking rates for the LCA groupings and the Ag Regions the following caveats need to be borne in mind.

1. Consideration should be given to how well the average represents the distribution when it is derived from strongly skewed or bimodal distributions.
2. In interpreting averages it should be borne in mind that the same average can result from markedly different distributions (as illustrated previously) and this may have implications for how the average value should be used in planning or decision making.
3. Since LCA determines the potential of land rather than the actual improvement made or the current intensity of use, this means that there is significant diversity of stocking rates within LCA classes and this diversity is also expressed in spatial heterogeneity. The heterogeneity is seen in strongly contrasting rates of stocking in adjacent holdings with similar mixes of LCA classes, reflecting the many other current and historical socio-economic factors that determine management regimens.
4. The use of any spatial unit (region) as a basis for summary will have an influence on the results. Careful account should be taken of regionalisation effects in any prioritisation or decision making, particularly the need to differentiate within the Highland AgRegion.

5. SUPPORTING ANALYSES

5.1. LCA Mix per Region

To provide context for the SR values the mix of LCA groupings for each AgRegion is presented for the mapped (Figure 13), forage (Figure 14), stocked (Figure 15) and unstocked (Figure 16) areas. The values are cross-tabulated in Section 6 (Supporting Tabular Data). The intention of deriving these figures is to indicate the absolute (ha) and relative (%) magnitude of the areas associated with each of the LCA groupings for each of the regions. The pairs of illustrations have previously been shown to be useful given the diversity in the range of AgRegion sizes. As above using absolute magnitudes alone for issues related to the LCA rough class means that Highland region tends to dominate and obscure the potential of other regions.

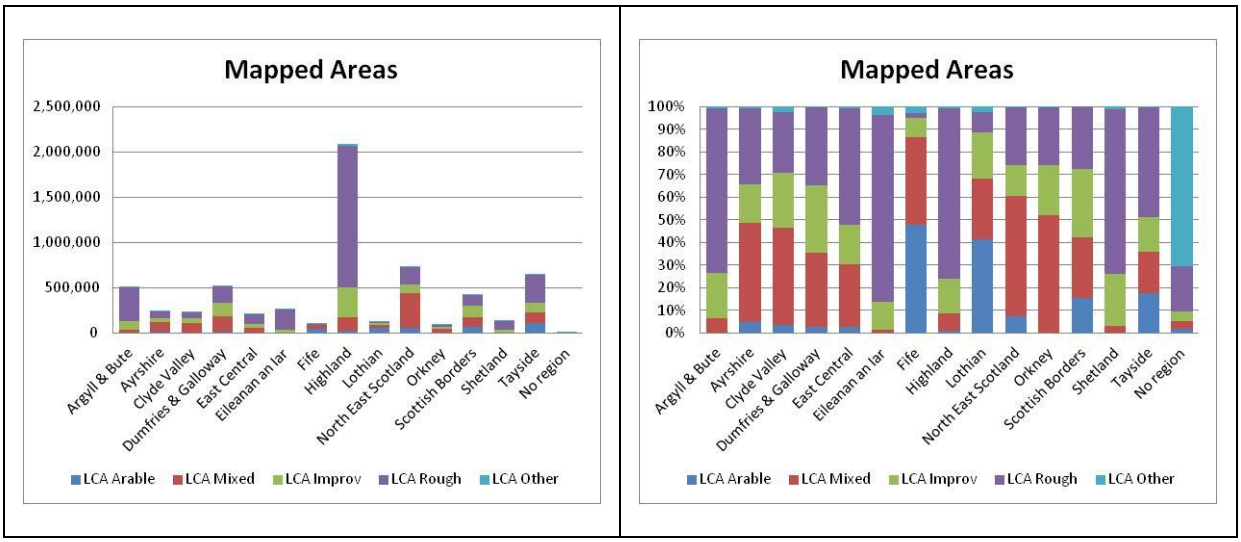

Figure 13

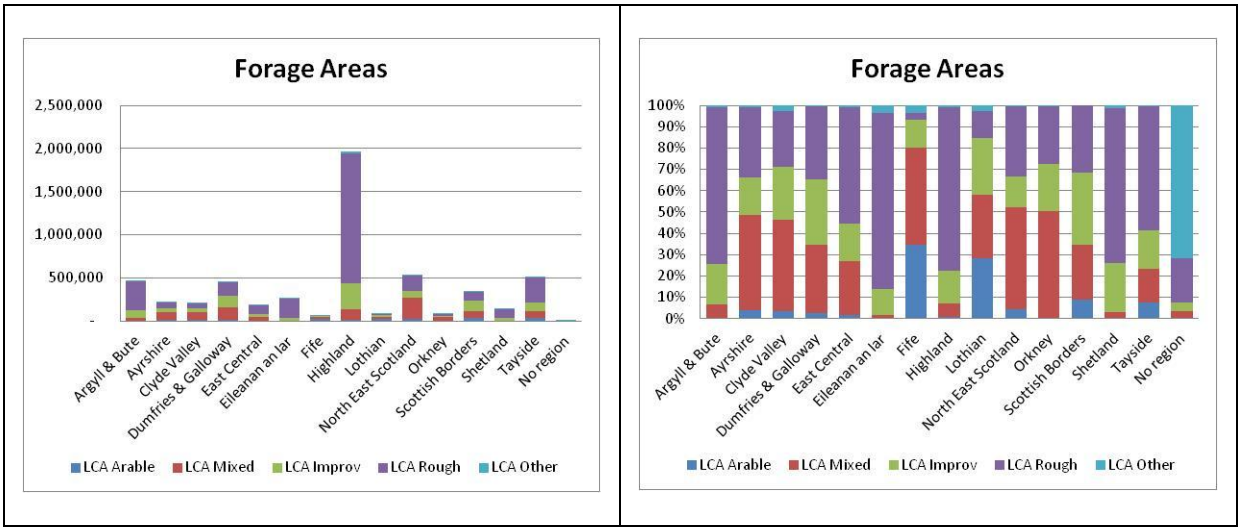

Figure 14

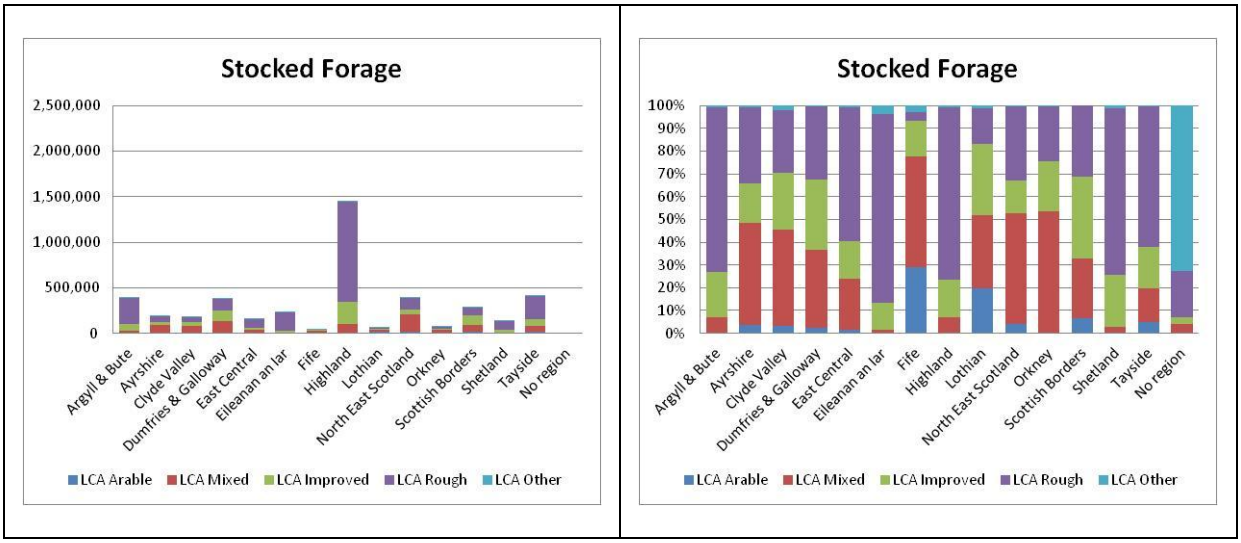

Figure 15

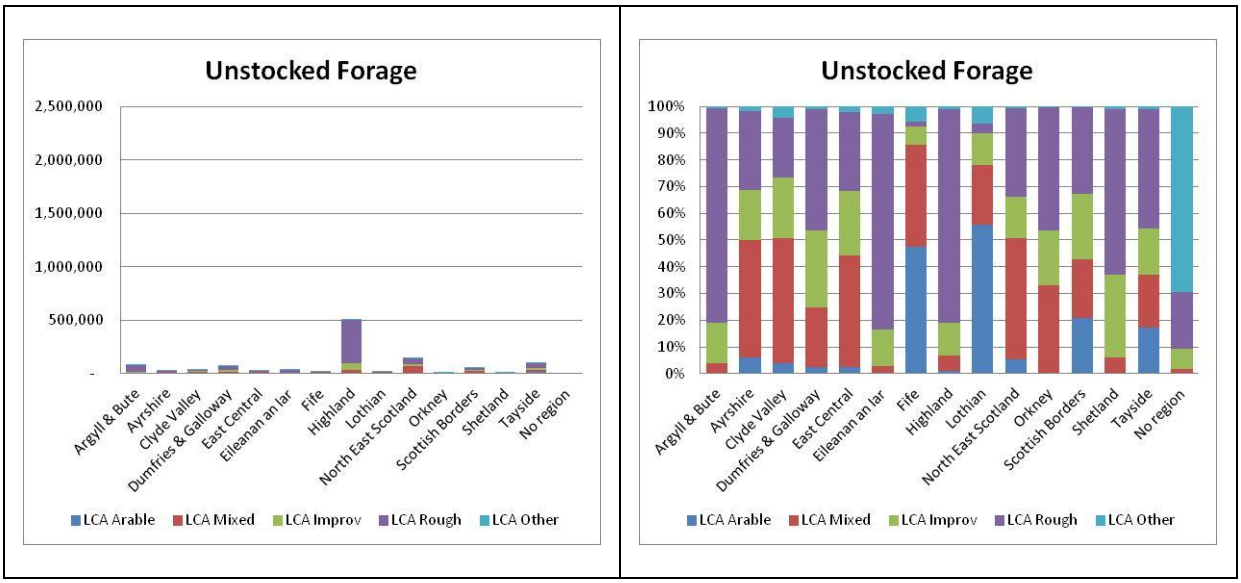

Figure 16

5.2. Forage Area Characteristics

To provide further context for the average SR values it is useful to define the areas associated with the SR values. In this case the geography is provided by AgRegions. Their use is justified since they are standard statistical regions and thus compatible with other data sources and their characteristics are readily comprehensible to stakeholders and decision makers. They are, however of markedly different sizes, ranging from Orkney at 87 thousand hectares to Highland at over 2 million hectares. There are thus 23 Orkney sized regions within Highland and not all (indeed perhaps none) of these regions would share the same characteristics as Highland overall. This makes interregional comparisons of magnitudes and determining the within-region significance of areas more complex. Highland region will tend to stand out or dominate in any area-based comparison of results. Whilst Highland undoubtedly presents the most significant opportunity for additional woodlands (with large areas of lightly stocked land), other regions also have substantial areas with similar characteristics. These may also need to be considered, especially if equity of burden sharing in terms of woodland expansion is seen as a priority. Table 4 presents the forage area (in hectares) for each of the LCA groupings cross-tabulated with AgRegion. The table has been shaded to highlight those regions with large areas of particular LCA groupings (dark green for the 75th percentile of area shading to brown for the 25th percentile).

Table 4: Forage area per AgRegion and LCA Grouping

Forage Area (ha)	LCA Grouping					
Region	**Arable**	**Mixed**	**Improved**	**Rough**	**Other**	**All LCA**
Argyll & Bute	736	29,479	88,861	341,812	2,882	463,770
Ayrshire	8,746	97,280	38,456	71,456	2,166	218,105
Clyde Valley	6,805	91,156	51,838	56,059	5,179	211,037
Dumfries & Galloway	10,819	144,866	136,635	154,391	1,978	448,688
East Central	2,878	46,614	32,681	100,176	1,497	183,845
Eileanan an Iar		4,265	32,489	222,804	9,357	268,917
Fife	19,228	25,197	7,202	1,713	2,068	55,408
Highland	11,705	125,768	299,706	1,506,579	17,883	1,961,642
Lothian	23,606	25,306	22,318	10,791	2,140	84,161
North East Scotland	22,819	250,689	77,757	173,206	1,621	526,092
Orkney		41,623	18,241	22,215	431	82,509
Scottish Borders	29,866	86,466	114,570	105,941	460	337,303
Shetland		4,031	31,880	100,026	1,597	137,534
Tayside	37,167	81,134	91,194	295,548	2,106	507,150
No Region	19	152	214	1,025	3,574	4,984
All Regions	**174,394**	**1,054,027**	**1,044,043**	**3,163,744**	**54,940**	**5,491,146**

Table 5 presents the same data but with the forage area as the percentage of the total mapped agricultural area. This table emphasises the differences between the regions in terms of the share of forage land Better quality land in the west tends to have larger proportions of forage land use on the best quality land, 75% Dumfries and Galloway versus 41% for Fife.

Table 5: Forage area as % of total agricultural area per AgRegion and LCA Grouping

Forage % of Agric	LCA Grouping					
Region	**Arable**	**Mixed**	**Improved**	**Rough**	**Other**	**All LCA**
Argyll & Bute	75%	90%	88%	92%	93%	91%
Ayrshire	76%	92%	91%	88%	94%	90%
Clyde Valley	84%	91%	92%	90%	88%	91%
Dumfries & Galloway	75%	87%	89%	88%	87%	87%
East Central	56%	83%	92%	96%	81%	90%
Eileanan an Iar		100%	100%	100%	92%	99%
Fife	41%	66%	87%	83%	75%	56%
Highland	50%	82%	92%	96%	97%	94%
Lothian	45%	74%	87%	93%	71%	66%
North East Scotland	42%	65%	81%	92%	81%	72%
Orkney		91%	96%	100%	96%	94%
Scottish Borders	45%	78%	90%	92%	78%	80%
Shetland		99%	100%	100%	100%	100%
Tayside	33%	69%	91%	95%	75%	79%
No Region	20%	80%	97%	96%	95%	93%
All Regions	44%	78%	90%	95%	90%	87%

6. SUPPORTING TABULAR DATA

6.1. Areas – mapped, forage, stocked and unstocked

Table 6: Total mapped area (ha) per AgRegion and LCA Grouping

Mapped Area (ha)	LCA Grouping					
Region	**Arable**	**Mixed**	**Improved**	**Rough**	**Other**	**All LCA**
Argyll & Bute	979	32,743	100,641	372,023	3,105	509,491
Ayrshire	11,493	106,274	42,260	80,852	2,317	243,196
Clyde Valley	8,080	100,535	56,247	62,073	5,894	232,829
Dumfries & Galloway	14,417	167,063	153,970	175,557	2,272	513,280
East Central	5,142	56,305	35,578	104,413	1,857	203,297
Eileanan an Iar		4,277	32,541	223,555	10,121	270,494
Fife	47,161	38,180	8,320	2,070	2,757	98,488
Highland	23,246	153,141	325,481	1,565,704	18,519	2,086,091
Lothian	52,413	34,222	25,664	11,660	3,011	126,970
North East Scotland	54,949	386,289	96,510	187,602	1,996	727,346
Orkney		45,629	19,021	22,296	448	87,394
Scottish Borders	65,677	111,049	127,019	114,946	590	419,282
Shetland		4,084	31,991	100,040	1,599	137,714
Tayside	112,991	117,888	99,930	311,238	2,820	644,867
No Region	95	191	220	1,072	3,767	5,345
All Regions	**396,645**	**1,357,871**	**1,155,394**	**3,335,101**	**61,073**	**6,306,084**

Table 7: Total forage area (ha) per Region and LCA Grouping

Forage Area (ha)	LCA Grouping					
Region	**Arable**	**Mixed**	**Improved**	**Rough**	**Other**	**All LCA**
Argyll & Bute	736	29,479	88,861	341,812	2,882	463,770
Ayrshire	8,746	97,280	38,456	71,456	2,166	218,105
Clyde Valley	6,805	91,156	51,838	56,059	5,179	211,037
Dumfries & Galloway	10,819	144,866	136,635	154,391	1,978	448,688
East Central	2,878	46,614	32,681	100,176	1,497	183,845
Eileanan an Iar		4,265	32,489	222,804	9,357	268,917
Fife	19,228	25,197	7,202	1,713	2,068	55,408
Highland	11,705	125,768	299,706	1,506,579	17,883	1,961,642
Lothian	23,606	25,306	22,318	10,791	2,140	84,161
North East Scotland	22,819	250,689	77,757	173,206	1,621	526,092
Orkney		41,623	18,241	22,215	431	82,509
Scottish Borders	29,866	86,466	114,570	105,941	460	337,303
Shetland		4,031	31,880	100,026	1,597	137,534
Tayside	37,167	81,134	91,194	295,548	2,106	507,150
No Region	19	152	214	1,025	3,574	4,984
All Regions	**174,394**	**1,054,027**	**1,044,043**	**3,163,744**	**54,940**	**5,491,146**

Table 8: Total stocked forage area (ha) per AgRegion and LCA Grouping

Stocked Area (ha)	LCA Grouping					
Region	**Arable**	**Mixed**	**Improved**	**Rough**	**Other**	**All LCA**
Argyll & Bute	687	26,438	76,757	278,126	2,421	384,430
Ayrshire	6,974	84,386	32,943	62,812	1,686	188,801
Clyde Valley	5,362	74,048	43,542	47,920	3,595	174,467
Dumfries & Galloway	9,026	128,773	115,644	121,360	1,356	376,159
East Central	2,125	34,765	25,767	91,771	919	155,347
Eileanan an Iar		3,354	27,771	195,501	8,418	235,045
Fife	11,252	18,817	6,015	1,421	1,123	38,628
Highland	6,620	96,429	237,706	1,098,907	11,797	1,451,458
Lothian	12,558	20,928	19,979	10,055	875	64,394
North East Scotland	15,163	187,076	56,047	126,148	916	385,350
Orkney		37,691	15,806	16,751	394	70,643
Scottish Borders	18,924	74,988	101,790	89,066	275	285,042
Shetland		3,618	29,832	95,897	1,519	130,867
Tayside	19,509	60,905	73,842	249,828	1,158	405,242
No Region	15	133	115	748	2,672	3,683
All Regions	**108,214**	**852,349**	**863,556**	**2,486,312**	**39,125**	**4,349,556**

Table 9 Total unstocked forage area (ha) per AgRegion and LCA Grouping

Unstocked Area (ha)	LCA Grouping					
Region	**Arable**	**Mixed**	**Improved**	**Rough**	**Other**	**All LCA**
Argyll & Bute	49	3,040	12,104	63,685	462	79,340
Ayrshire	1,772	12,895	5,513	8,644	480	29,304
Clyde Valley	1,443	17,108	8,296	8,139	1,584	36,570
Dumfries & Galloway	1,793	16,093	20,991	33,031	621	72,529
East Central	752	11,849	6,914	8,404	578	28,498
Eileanan an Iar	-	912	4,718	27,303	939	33,872
Fife	7,976	6,380	1,187	292	945	16,780
Highland	5,086	29,339	62,001	407,672	6,086	510,184
Lothian	11,048	4,378	2,339	737	1,265	19,767
North East Scotland	7,656	63,613	21,710	47,058	705	140,742
Orkney	-	3,932	2,434	5,464	36	11,867
Scottish Borders	10,942	11,478	12,781	16,875	184	52,261
Shetland	-	413	2,048	4,128	78	6,667
Tayside	17,658	20,229	17,352	45,720	949	101,908
No Region	4	19	99	278	902	1,301
All Regions	**66,180**	**201,678**	**180,486**	**677,431**	**15,815**	**1,141,590**

6.2. Livestock Numbers

Table 10: Total Livestock Units per AgRegion and LCA Grouping

Total LSU	LCA Grouping					
Region	LCA Arable	LCA Mixed	LCA Improv	LCA Rough	LCA Other	All LCA
Argyll & Bute	1,327	20,021	25,112	40,504	634	87,599
Ayrshire	13,200	124,317	22,672	23,412	1,668	185,268
Clyde Valley	8,493	96,576	25,072	12,233	4,211	146,585
Dumfries & Galloway	21,364	203,778	103,603	51,462	1,831	382,039
East Central	3,798	37,451	10,357	14,639	960	67,205
Eileanan an Iar		811	4,258	12,468	561	18,097
Fife	23,106	29,375	8,531	1,620	1,525	64,156
Highland	9,359	66,767	35,150	91,165	1,562	204,003
Lothian	21,927	22,941	11,481	3,221	1,190	60,761
North East Scotland	36,996	298,451	27,808	19,692	1,006	383,954
Orkney		45,606	15,007	7,175	313	68,101
Scottish Borders	30,960	73,144	57,298	22,781	258	184,441
Shetland		973	6,904	15,894	334	24,105
Tayside	51,698	64,896	25,360	36,948	817	179,719
No Region	24	139	37	330	794	1,325
All Regions	**222,252**	**1,085,245**	**378,650**	**353,545**	**17,663**	**2,057,357**

Note that it is not possible to derive the average SRs simply by combining the total lsu and the forage area. The average SR is an area weighted average of the individual SR bins not the overall totals.

6.3. Area Weighted Average Intermediate Tables

Table 11: Distribution of forage areas (ha) per stocking rate, AgRegion, LCA Grouping

Forage Area (ha)		**LCA Group**					
Region	Bin Values	Arable	Mixed	Improv	Rough	Other	All LCA
Argyll & Bute	All SRs	**736**	**29,479**	**88,861**	**341,812**	**2,882**	**463,770**
	SR=0	49	3,040	12,104	63,685	462	79,340
	SR<=0.25	8	6,561	43,144	240,060	1,759	291,533
	SR<=0.5	44	7,064	20,889	31,806	422	60,225
	SR<=1.0	215	6,490	8,796	5,525	141	21,167
	SR<=2.0	218	4,271	3,360	687	65	8,601
	SR<=4.0	109	2,028	536	48	31	2,752
	SR>>4.0	93	25	31	-	3	152
Ayrshire	All SRs	**8,746**	**97,280**	**38,456**	**71,456**	**2,166**	**218,105**
	SR=0	1,772	12,895	5,513	8,644	480	29,304
	SR<=0.25	346	5,679	9,142	31,841	181	47,189
	SR<=0.5	403	6,180	5,659	11,263	461	23,967
	SR<=1.0	740	19,212	12,297	17,776	400	50,426
	SR<=2.0	2,573	32,046	4,768	1,512	391	41,291
	SR<=4.0	2,602	20,210	935	364	238	24,350
	SR>>4.0	308	1,058	141	56	15	1,578
Clyde Valley	All SRs	**6,805**	**91,156**	**51,838**	**56,059**	**5,179**	**211,037**
	SR=0	1,443	17,108	8,296	8,139	1,584	36,570
	SR<=0.25	328	5,458	12,892	32,958	308	51,944
	SR<=0.5	271	7,665	12,878	8,125	304	29,242
	SR<=1.0	959	19,514	11,326	5,710	1,618	39,127
	SR<=2.0	2,357	28,757	5,256	1,013	953	38,335
	SR<=4.0	1,438	11,763	1,134	101	354	14,789
	SR>>4.0	9	892	56	13	59	1,030
Dumfries & Galloway	All SRs	**10,819**	**144,866**	**136,635**	**154,391**	**1,978**	**448,688**
	SR=0	1,793	16,093	20,991	33,031	621	72,529
	SR<=0.25	253	6,233	17,251	53,638	121	77,496
	SR<=0.5	210	12,715	29,791	39,492	59	82,268
	SR<=1.0	685	25,214	32,517	19,514	456	78,386
	SR<=2.0	3,273	50,263	26,467	7,165	523	87,691
	SR<=4.0	3,702	30,156	8,654	1,245	149	43,906
	SR>>4.0	904	4,191	964	305	48	6,413
East Central	All SRs	**2,878**	**46,614**	**32,681**	**100,176**	**1,497**	**183,845**
	SR=0	752	11,849	6,914	8,404	578	28,498
	SR<=0.25	230	3,991	12,446	73,177	156	90,001
	SR<=0.5	187	5,228	7,254	17,428	134	30,231
	SR<=1.0	399	10,444	3,896	955	236	15,931
	SR<=2.0	607	11,226	1,855	182	286	14,156
	SR<=4.0	543	3,426	294	29	100	4,393
	SR>>4.0	158	450	21	0	6	635
Eileanan an Iar	All SRs	**-**	**4,265**	**32,489**	**222,804**	**9,357**	**268,917**

	SR=0		912	4,718	27,303	939	33,872
	SR<=0.25		2,679	24,796	193,063	8,306	228,845
	SR<=0.5		292	2,076	1,603	59	4,030
	SR<=1.0		319	577	550	42	1,488
	SR<=2.0		30	179	140	5	353
	SR<=4.0		22	110	116	6	254
	SR>>4.0		11	33	29	1	74
Fife	All SRs	**19,228**	**25,197**	**7,202**	**1,713**	**2,068**	**55,408**
	SR=0	7,976	6,380	1,187	292	945	16,780
	SR<=0.25	697	965	145	20	27	1,854
	SR<=0.5	1,009	826	286	59	194	2,375
	SR<=1.0	1,624	4,705	2,567	763	298	9,958
	SR<=2.0	4,286	7,811	2,211	453	417	15,178
	SR<=4.0	2,198	3,627	418	96	134	6,474
	SR>>4.0	1,438	883	388	29	51	2,790
Highland	All SRs	**11,705**	**125,768**	**299,706**	**1,506,579**	**17,883**	**1,961,642**
	SR=0	5086	29339	62001	407672	6086	510,184
	SR<=0.25	673	31437	201890	1009235	10402	1,253,638
	SR<=0.5	905	15905	20467	77773	683	115,733
	SR<=1.0	1654	25194	10603	9243	328	47,021
	SR<=2.0	2234	19730	4225	2171	334	28,693
	SR<=4.0	724	3576	430	341	43	5,114
	SR>>4.0	430	587	91	144	6	1,259
Lothian	All SRs	**23,606**	**25,306**	**22,318**	**10,791**	**2,140**	**84,161**
	SR=0	11,048	4,378	2,339	737	1,265	19,767
	SR<=0.25	1,745	1,966	7,568	6,647	64	17,990
	SR<=0.5	720	2,848	4,276	1,690	145	9,678
	SR<=1.0	2,412	7,887	5,299	1,264	257	17,119
	SR<=2.0	4,395	6,020	2,439	382	258	13,494
	SR<=4.0	2,197	1,934	267	41	119	4,558
	SR>>4.0	1,090	272	130	31	32	1,555
North East Scotland	All SRs	**22,819**	**250,689**	**77,757**	**173,206**	**1,621**	**526,092**
	SR=0	7,656	63,613	21,710	47,058	705	140,742
	SR<=0.25	977	14,599	25,814	103,725	377	145,491
	SR<=0.5	522	16,143	14,975	16,186	26	47,853
	SR<=1.0	1,790	39,370	9,069	3,484	105	53,818
	SR<=2.0	5,166	72,104	4,574	2,114	272	84,230
	SR<=4.0	5,337	37,466	1,396	537	114	44,850
	SR>>4.0	1,371	7,393	219	103	22	9,108
Orkney	All SRs	**-**	**41,623**	**18,241**	**22,215**	**431**	**82,509**
	SR=0		3,932	2,434	5,464	36	11,867
	SR<=0.25		3,012	2,768	10,152	144	16,076
	SR<=0.5		3,215	1,874	1,647	27	6,764
	SR<=1.0		7,813	4,517	2,708	86	15,124
	SR<=2.0		20,248	5,567	1,883	122	27,820
	SR<=4.0		3,118	910	360	11	4,400

	SR>>4.0		285	171	-	3	459
Scottish Borders	All SRs	**29,866**	**86,466**	**114,570**	**105,941**	**460**	**337,303**
	SR=0	10,942	11,478	12,781	16,875	184	52,261
	SR<=0.25	817	7,594	24,162	59,302	58	91,932
	SR<=0.5	1,178	9,464	30,577	21,825	61	63,105
	SR<=1.0	5,394	28,843	33,349	6,056	89	73,730
	SR<=2.0	6,501	23,738	12,633	1,662	45	44,580
	SR<=4.0	3,907	5,155	1,010	216	16	10,304
	SR>>4.0	1,127	194	58	5	7	1,391
Shetland	All SRs	**-**	**4,031**	**31,880**	**100,026**	**1,597**	**137,534**
	SR=0		413	2,048	4,128	78	6,667
	SR<=0.25		2,550	22,390	86,486	1,321	112,748
	SR<=0.5		557	4,763	7,687	129	13,136
	SR<=1.0		444	2,308	1,466	58	4,275
	SR<=2.0		64	314	166	4	548
	SR<=4.0		3	37	20	1	61
	SR>>4.0		-	20	73	6	99
Tayside	All SRs	**37,167**	**81,134**	**91,194**	**295,548**	**2,106**	**507,150**
	SR=0	17,658	20,229	17,352	45,720	949	101,908
	SR<=0.25	1,704	13,931	45,129	209,037	706	270,506
	SR<=0.5	2,095	10,261	14,089	35,149	146	61,740
	SR<=1.0	3,431	16,222	9,378	4,128	85	33,244
	SR<=2.0	5,119	14,476	4,292	1,127	90	25,104
	SR<=4.0	4,913	4,645	803	297	76	10,734
	SR>>4.0	2,246	1,370	152	90	55	3,913
No Region	All SRs	**19**	**152**	**214**	**1,025**	**3,574**	**4,984**
	SR=0	4	19	99	278	902	1,301
	SR<=0.25	1	29	80	481	1933	2,523
	SR<=0.5	1	14	10	96	211	332
	SR<=1.0	1	38	16	55	371	481
	SR<=2.0	10	46	7	89	129	281
	SR<=4.0	3	5	2	24	20	53
	SR>>4.0	0	2	0	3	9	15
All Regions	All SRs	**174,394**	**1,054,027**	**1,044,043**	**3,163,744**	**54,940**	**5,491,146**
	SR=0*	66,180	201,678	180,486	677,431	15,815	1,141,590
	SR<=0.25	7,777	106,685	449,618	2,109,822	25,862	2,699,764
	SR<=0.5	7,546	98,377	169,866	271,829	3,062	550,679
	SR<=1.0	19,303	211,709	146,514	79,197	4,571	461,294
	SR<=2.0	36,739	290,829	78,148	20,746	3,894	430,356
	SR<=4.0	27,673	127,135	16,937	3,837	1,412	176,993
	SR>>4.0	9,176	17,613	2,474	882	324	30,470

* note that the zero SR class includes 49,824 Ha of temporary grassland and 92,533 Ha of permanent grassland where no stack were associated with the holding in JAC or DS.

Table 12: Distribution of Average SR values per stocking rate, AgRegion, LCA Grouping

Average SR per bin		LCA_CLASS					
Region	Bins	Arable	Mixed	Improv	Rough	Other	All LCA
Argyll & Bute	SR=0	-	-	-	-	-	-
	SR<=0.25	0.24	0.15	0.14	0.13	0.12	0.13
	SR<=0.5	0.44	0.36	0.36	0.36	0.35	0.36
	SR<=1.0	0.72	0.73	0.70	0.65	0.67	0.70
	SR<=2.0	1.65	1.50	1.47	1.49	1.55	1.49
	SR<=4.0	2.92	2.55	2.46	2.44	2.55	2.54
	SR>>4.0	4.73	5.23	8.25		7.79	5.77
Ayrshire	SR=0	-	-	-	-	-	-
	SR<=0.25	0.17	0.15	0.14	0.14	0.15	0.15
	SR<=0.5	0.36	0.39	0.38	0.39	0.37	0.38
	SR<=1.0	0.74	0.73	0.72	0.73	0.73	0.73
	SR<=2.0	1.50	1.47	1.42	1.38	1.42	1.46
	SR<=4.0	2.61	2.56	2.42	2.54	2.51	2.56
	SR>>4.0	5.14	7.38	15.82	28.90	5.88	8.45
Clyde Valley	SR=0	-	-	-	-	-	-
	SR<=0.25	0.14	0.15	0.15	0.13	0.14	0.14
	SR<=0.5	0.37	0.38	0.35	0.37	0.37	0.37
	SR<=1.0	0.73	0.75	0.76	0.74	0.78	0.76
	SR<=2.0	1.52	1.47	1.40	1.36	1.46	1.46
	SR<=4.0	2.72	2.59	2.55	2.60	2.66	2.60
	SR>>4.0	10.07	6.81	9.05	4.79	6.94	7.02
Dumfries & Galloway	SR=0	-	-	-	-	-	-
	SR<=0.25	0.12	0.16	0.17	0.17	0.15	0.16
	SR<=0.5	0.33	0.38	0.37	0.37	0.36	0.37
	SR<=1.0	0.75	0.78	0.76	0.73	0.79	0.76
	SR<=2.0	1.55	1.48	1.43	1.37	1.47	1.46
	SR<=4.0	2.72	2.61	2.57	2.56	2.67	2.61
	SR>>4.0	5.89	6.15	6.58	6.24	7.16	6.22
East Central	SR=0	-	-	-	-	-	-
	SR<=0.25	0.11	0.15	0.13	0.12	0.13	0.13
	SR<=0.5	0.36	0.37	0.35	0.34	0.39	0.36
	SR<=1.0	0.78	0.78	0.75	0.72	0.75	0.77
	SR<=2.0	1.51	1.33	1.29	1.24	1.37	1.34
	SR<=4.0	2.55	2.54	2.40	2.44	2.37	2.52
	SR>>4.0	11.98	6.86	7.07	5.07	12.09	8.36
Eileanan an Iar	SR=0		-	-	-	-	-
	SR<=0.25		0.10	0.10	0.09	0.08	0.09
	SR<=0.5		0.36	0.35	0.34	0.35	0.35
	SR<=1.0		0.73	0.68	0.69	0.68	0.69
	SR<=2.0		1.44	1.48	1.39	1.29	1.42
	SR<=4.0		2.69	2.78	2.69	2.82	2.75
	SR>>4.0		6.00	13.32	14.44	15.93	12.80

Fife	SR=0	-	-	-	-	-	-
	SR<=0.25	0.09	0.08	0.08	0.08	0.04	0.08
	SR<=0.5	0.37	0.38	0.44	0.39	0.41	0.39
	SR<=1.0	0.76	0.77	0.77	0.74	0.77	0.76
	SR<=2.0	1.47	1.39	1.38	1.43	1.40	1.41
	SR<=4.0	2.52	2.56	2.58	2.64	2.50	2.55
	SR>>4.0	7.06	6.87	6.62	5.60	6.31	6.85
Highland	SR=0	-	-	-	-	-	-
	SR<=0.25	0.12	0.11	0.10	0.09	0.07	0.10
	SR<=0.5	0.37	0.37	0.36	0.35	0.35	0.36
	SR<=1.0	0.77	0.75	0.72	0.72	0.72	0.74
	SR<=2.0	1.47	1.34	1.29	1.36	1.35	1.35
	SR<=4.0	2.50	2.47	2.46	2.50	2.61	2.48
	SR>>4.0	5.89	6.92	8.34	6.54	4.82	6.72
Lothian	SR=0	-	-	-	-	-	-
	SR<=0.25	0.12	0.15	0.14	0.15	0.13	0.14
	SR<=0.5	0.35	0.37	0.37	0.38	0.37	0.37
	SR<=1.0	0.76	0.77	0.76	0.80	0.78	0.77
	SR<=2.0	1.41	1.36	1.35	1.29	1.39	1.37
	SR<=4.0	2.77	2.62	2.56	2.64	2.61	2.67
	SR>>4.0	7.51	8.28	9.42	5.81	7.27	7.84
North East Scotland	SR=0	-	-	-	-	-	-
	SR<=0.25	0.10	0.13	0.12	0.10	0.09	0.12
	SR<=0.5	0.40	0.39	0.37	0.37	0.41	0.38
	SR<=1.0	0.78	0.77	0.76	0.77	0.78	0.77
	SR<=2.0	1.54	1.44	1.43	1.44	1.44	1.45
	SR<=4.0	2.78	2.65	2.67	2.59	2.63	2.67
	SR>>4.0	10.40	8.05	12.33	9.25	6.32	8.68
Orkney	SR=0		-	-	-	-	-
	SR<=0.25		0.13	0.13	0.13	0.13	0.13
	SR<=0.5		0.38	0.36	0.37	0.38	0.38
	SR<=1.0		0.79	0.80	0.76	0.76	0.79
	SR<=2.0		1.44	1.38	1.39	1.42	1.42
	SR<=4.0		2.40	2.39	2.29	2.42	2.40
	SR>>4.0		6.53	4.91		4.49	5.77
Scottish Borders	SR=0	-	-	-	-	-	-
	SR<=0.25	0.09	0.14	0.15	0.14	0.14	0.15
	SR<=0.5	0.39	0.38	0.37	0.37	0.37	0.37
	SR<=1.0	0.77	0.76	0.73	0.72	0.74	0.75
	SR<=2.0	1.44	1.34	1.27	1.23	1.37	1.33
	SR<=4.0	2.66	2.57	2.43	2.56	2.53	2.58
	SR>>4.0	6.49	8.42	6.59	21.69	7.16	7.14
Shetland	SR=0		-	-	-	-	-
	SR<=0.25		0.15	0.14	0.14	0.13	0.14
	SR<=0.5		0.38	0.36	0.34	0.34	0.35
	SR<=1.0		0.71	0.68	0.67	0.68	0.68

	SR<=2.0		1.26	1.29	1.24	1.24	1.27
	SR<=4.0		2.58	2.58	2.45	3.62	2.77
	SR>>4.0			6.28	13.50	10.80	8.43
Tayside	SR=0	-	-	-	-	-	-
	SR<=0.25	0.12	0.14	0.12	0.11	0.11	0.12
	SR<=0.5	0.38	0.38	0.38	0.37	0.37	0.38
	SR<=1.0	0.76	0.74	0.71	0.71	0.73	0.73
	SR<=2.0	1.43	1.35	1.28	1.33	1.34	1.35
	SR<=4.0	2.79	2.64	2.45	2.49	2.72	2.67
	SR>>4.0	11.88	11.34	5.57	6.45	9.47	11.13
No Region	SR=0	-	-	-	-	-	-
	SR<=0.25	0.11	0.11	0.11	0.10	0.11	0.11
	SR<=0.5	0.34	0.36	0.35	0.34	0.35	0.35
	SR<=1.0	0.77	0.75	0.69	0.73	0.71	0.72
	SR<=2.0	1.52	1.43	1.40	1.39	1.36	1.40
	SR<=4.0	2.37	2.66	2.52	2.55	2.59	2.58
	SR>>4.0	4.89	5.46	7.70	9.23	7.56	7.00
All Regions	SR=0	-	-	-	-	-	-
	SR<=0.25	0.12	0.13	0.13	0.12	0.10	0.12
	SR<=0.5	0.37	0.38	0.37	0.36	0.36	0.37
	SR<=1.0	0.76	0.76	0.74	0.73	0.74	0.75
	SR<=2.0	1.49	1.43	1.39	1.37	1.42	1.43
	SR<=4.0	2.70	2.60	2.54	2.55	2.59	2.60
	SR>>4.0	8.43	7.48	8.24	9.26	7.33	7.87