Animal &
Plant Health
Agency

Livestock Demographic Data Group:
Sheep population report

Livestock population density maps for GB 2020, using winter 2018/19 data

APHA is an Executive Agency of the Department for Environment, Food and Rural Affairs and also works on behalf of the Scottish Government, Welsh Government and Food Standards Agency to safeguard animal and plant health for the benefit of people, the environment and the economy.

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LDDG	Sheep
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Data source	Sheep and Goat Inventory / Rapid Analysis and Detection of Animal related Risk (RADAR) data warehouse
Data year	Winter 2018 / 2019 (Reported in December 2018 for England, and January 2019 for Scotland and Wales)

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Contents

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Who are these reports for and what is their purpose?

These reports provide an estimate of the distribution and size of the sheep population at GB level. This type of population level information is often required for use in animal health and welfare policy work which requires to assess the economic or social impact of particular policies, for contingency, disease control and resource planning.

Who did this work?

The reports are produced by the Livestock Demographic Data Groups (LDDG). The LDDGs were formed in January 2014 and are made up of APHA representatives from data, epidemiology, species expert and GIS work groups.

What do the data show about the population?

The maps (Figures 1 and 2) show either the density of animals, with a small map to show how this compares with the density of holdings, or vice versa.

In line with common understanding of the population, the maps show that the sheep holdings and sheep population of GB is largely distributed across Wales, northern England and southern Scotland, with additional focal areas of high population density in south-west and south east England.

Although there is a seasonal pattern in movement and numbers of sheep affecting the animal density, with higher numbers in summer reflecting the annual lamb crop, the geographical distribution of the population is similar in the June and January data.

What do the data not show about the population?

The data from the annual Sheep and Goat Inventory will not show the majority of lambs as most are born after the inventory takes place (December/January each year) and will be slaughtered prior to the next inventory.

Comparison against data from the Agricultural Survey full census in 2010, indicated that the sheep population increases by approximately 70% between the dates the surveys are taken. The planned 2020 census has been postponed due to the coronavirus outbreak.

How accurate are the data?

There are important assumptions and uncertainties with these estimates which the user needs to take into consideration. Limitations in the dataset are discussed in the supporting quality statement (Annex 1) and it is important that the user considers these in the context of their work. Population and holding density maps are classified to different scales and units from each other and due care must be taken regarding their interpretation.

The Sheep and Goat Inventory holds information about the location and animal count of sheep holdings in GB in winter. This is described in the data quality statement and has been represented by Figures 1 and 2.

The data are derived from the approximately 72% of registered sheep holdings in Scotland and 82% in England and Wales that return a response to the inventory survey. The characteristics of the non-responders are unknown and the effect of these missing data has not been evaluated. It is not expected that the fact that England's data is taken a month earlier (December) than Scotland and Wales (January) would have any effect on Figures 1 and 2. The supporting quality statement provides further detail on the limitations in the data (Annex 1).

How were the maps produced?

The maps have been created using the kernel density function in ArcGIS software. This tool distributes population information over a defined radius (15km radius used for the figures presented within this report), creating a smooth density surface. Two key parameters that require adjustment are the **search radius distance** and the size of the **output surface grid**. Discussion at the LDDG meetings informed these criteria, and their selection is recognised as a subjective process (Pfeiffer et al., 2008). A search radius of 15km was deemed sufficient to enable distinction between categories and a 1km grid square was used for the density surfaces themselves. The classification bins were limited to six, to aide in cross referencing areas of the map to the key.

Comparison between the maps was optimised by assigning similar parameters between the species. However, further refinement of the parameters for each species' dataset could represent the information more accurately. Note that the ArcGIS Kernel Density tool does not take into account edge effects, and as such density estimates in and around coastal areas may be under estimated (Charpentier & Gallic, 2016).

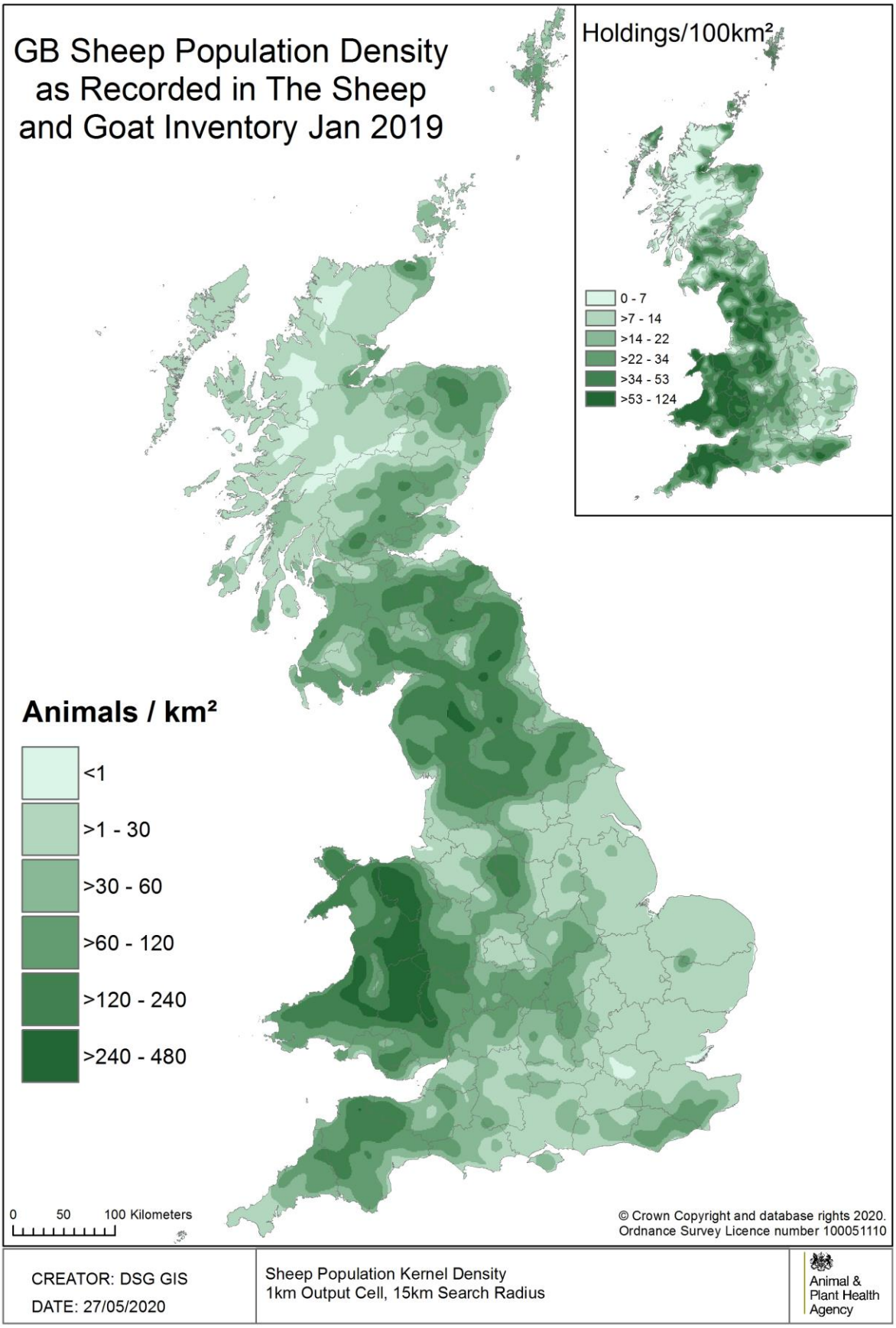

Figure 1 Sheep population density in GB (Sheep and Goat Inventory).

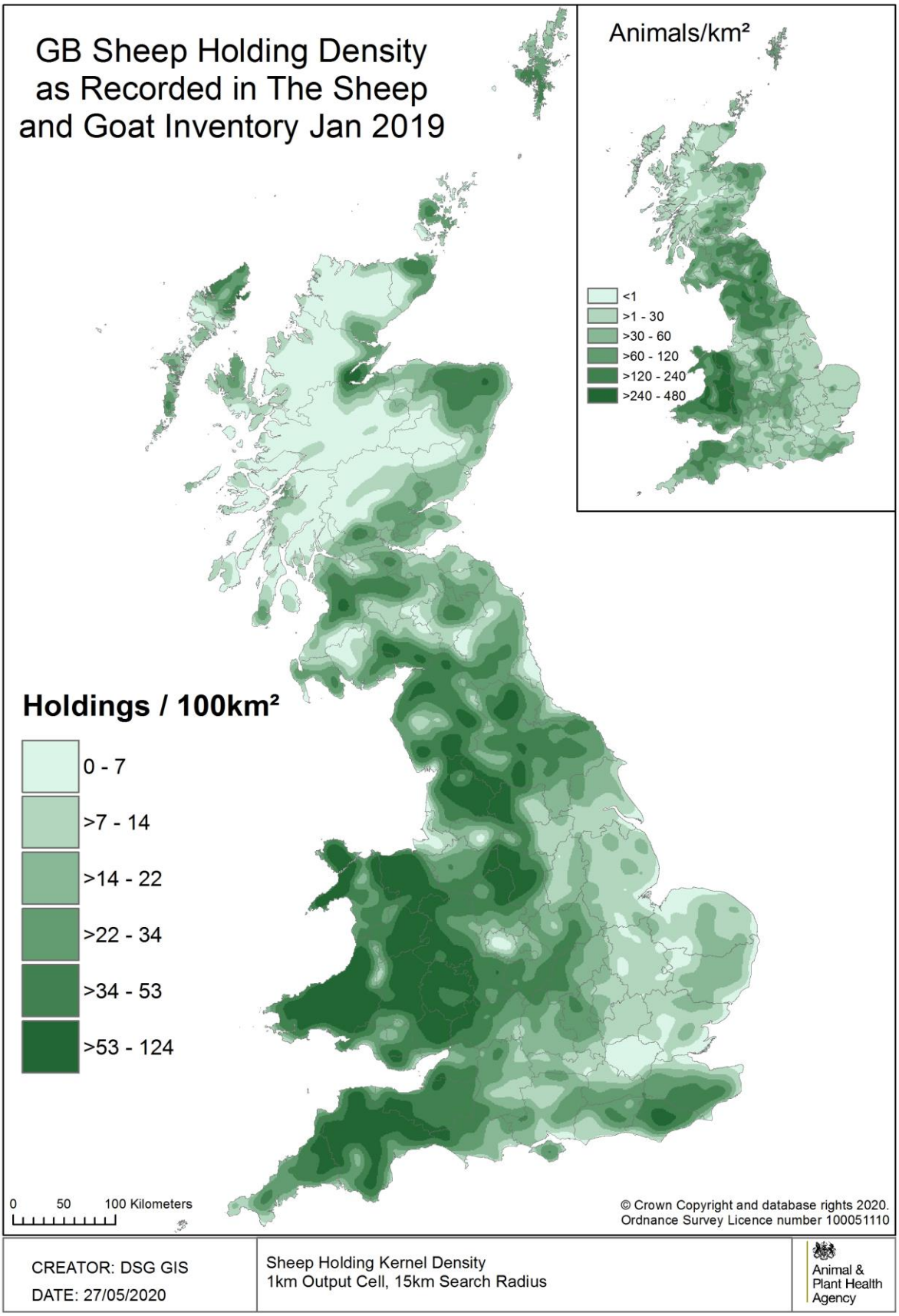

Figure 2 Sheep holding density in GB (Sheep and Goat Inventory)

Acknowledgements

The LDDG are grateful to Defra, Welsh Government, Scottish Government, IBM and APHA Weybridge DSG staff who handle the Sheep and Goat Inventory data and Rapid Analysis and Detection of Animal Related Risks (RADAR) data warehouse for their assistance in producing this report.

References

Charpentier, A., & Gallic, E. (2016). Kernel density estimation based on Ripley's correction. *GeoInformatica*, *20*(1), 95–116. https://doi.org/10.1007/s10707-015-0232-z

Pfeiffer, D. U., Robinson, T. P., Stevenson, M., Stevens, K. B., Rogers, D. J., & Clements, A. C. A. (2008). *Spatial Analysis in Epidemiology* (1st ed.). Oxford University Press.

Annex 1: Data quality statement for sheep (March 2020)

Introduction

This data quality statement provides an overview of the quality of the data used to underpin the kernel density holding and livestock maps. This statement is written in the context of the data being used to provide an overview of the livestock demographics within Great Britain. The statement may not necessarily relate to data quality for other purposes.

Overview and purpose of source data used

Data were supplied by the Data Systems Group (DSG), APHA Weybridge and sourced from the Sheep and Goat Inventory via the APHA Rapid Analysis and Detection of Animal-related Risks (RADAR) data warehouse.

Sheep and Goat inventory (via RADAR) was chosen to represent the sheep and goat data as this has the most inclusive coverage on holdings across GB. This dataset records the number of sheep and goats kept on all registered individual premises. The inventory data is collected once a year (1st December for England and 1st January for Scotland and Wales) by means of questionnaire cards which are sent to every registered sheep holding in GB. This gives a winter count of the population. There is a response rate of between 72% (for Scotland) and 82% (for England and Wales) for each annual survey.

The Agricultural Survey was also considered. This data is collected in the summer months and so would include lambing data which would therefore show a much larger population than that in the Sheep and Goat inventory. However, this survey only holds data on larger agricultural holdings and not on small holdings. It was therefore decided that the sheep and goat inventory gave a better picture of all holdings in Great Britain and that the agricultural survey would still be used if it was decided that a summer count was more relevant. As a rule of thumb, sheep numbers are approximately 70% higher in summer due to the presence of the lamb crop.

The Animal Movement Licensing System database (AMLS) was also considered as a source for these data, but this only shows movements on batches of animals and not individual counts and so it was decided this was not suitable.

Category ***[definition]***	**Quality description**
Relevance of data *[degree to which data meets user needs in terms of currency, geographical coverage, content and detail]*	**Spatial coverage:** The data cover GB (England, Scotland and Wales). **Temporal coverage:** The data presented are for December 1st 2018 (England) and January 1st 2019 (Scotland and Wales). The data were accessed in December 2019. **Key data items available:** The dataset includes species (sheep or goat) and number of animals on holding, purpose of holding, CPH, name and address of keeper/holding.
Timeliness *[the degree to which data represent reality from the required time point]*	**How often are the data collected?** The data are collected annually on December 1st for England and January 1st for Scotland and Wales. **When does the data become available?** The data are available and uploaded into RADAR about 6 months after the survey is collected by the Defra Statistics Team based in York ('York Stats'). **Data reference period:** The data are a snapshot at the date of the survey. **How often are the data updated?** Data are updated annually.
Accuracy and precision *[extent of data error and bias and how well data portrays reality]*	**How were the data collected?** Inventory cards are sent once a year by post to all holdings that have registered as keeping sheep or goats and asked to be completed and returned. **Sample & collection size:** All holdings registered as keeping sheep or goats are sent a form and is intended as a full census. It is not known how many eligible holdings have not registered. The sample consists of all the holdings that have returned the inventory form. **Further information on rules for registering a holding where sheep and goats are kept:** https://www.gov.uk/sheep-and-goats-identification-registration-and-movement **What steps have been taken to minimise processing errors?** Further investigation is required to identify what work has been done to review the accuracy of the data from Wales and Scotland.

	The data collected through the survey in England is subject to manual validation to check the data accuracy. Not all data that fails validation can be corrected/confirmed as the survey team cannot always get hold of the keeper. There are a number of different errors that can be detected such as incorrect flock number, or illegible forms. The team check every form and verify the information where possible. **What are the response rates?** Response rates for surveys between 2017 and 2018 are estimated to be 72-82%. **Are any parts of the population unaccounted for in the data collection?** The Defra Statistics Team do not receive returns from around 18% and 22% of holdings surveyed, from England/Wales and Scotland respectively. However, it is not known whether non-responders represent particular parts of the population. There may also be holdings that are not registered, and so are unknown, which is something that will be investigated further. There is guidance on how to register your holding and flock or herd at: https://www.gov.uk/guidance/sheep-and-goat-keepers-register-your-holding-and-flock-or-herd More information on how to keep and update a holding register in the annual sheep and goat inventory at: https://www.gov.uk/guidance/sheep-and-goat-keepers-how-to-keep-a-holding-register
Comparability [*how well these data can be compared with data taken from the same dataset and with similar data from other sources]*	**Within dataset comparability:** The format and survey methods are similar between years. Comparison of the data across previous years indicates sheep populations appear to have increased slightly each year. **Other dataset comparability:** The data compares with the Agricultural Survey, which shows data collected in the summer and therefore also includes lamb populations (there was an approximately 90% increase in the estimated sheep population in England between the population in this report and the following summer survey). AMLS holds movement data, which can compare knowledge of holding locations and relative sizes. However, both datasets have a difference in data capture, as does data held within Sam; work is ongoing to further investigate the comparability of these datasets.
Coherence	**How consistent are the data over time? If there are differences, what are they and what is their impact? Have there been changes to the underlying data collection?** The

[*degree to which data can be or have been merged with other data sources]*	sheep population was split into 'breeding and 'other' several years ago otherwise no major changes in the data itself. It appears data collection procedures have changed over the past years in Wales, with farmers reporting different holdings in one form. Therefore, several holdings may be recorded as one holding. **Have any real world events impacted on the data since the previous release?** Delays in the production and publication of this report as a result of Covid-19. **What other data sources are these data comparable with?** Location data are comparable between the Agricultural survey, Sam and the Animal Movement Licensing System (AMLS). The Agricultural survey data has been used for total population and the AMLS for total holdings. **What other data sources in society report similar information? How do these data sources compare?** Industry has their own datasets but these are obtained from, for example, the sheep and goat inventory and Agricultural Survey. It is thought they are unlikely to offer any additional information.
Interpretability *[how well the data is understood and utilised appropriately]*	**Is there a particular context that this data needs to be considered within?** This is a winter survey and as sheep form a seasonal dynamic population the numbers will be much higher during the summer post lambing. **What other information is available to help users better understand this data source?** There is a metadata catalogue for RADAR available at http://ahvlaintranet/day-to-day/tools-and-applications/Pages/radar.aspx **Are there any ambiguous or technical terms that may need further explanation?** No.

Accessibility [*availability of relevant information and access to the data in a convenient and suitable manner]*	**What data are shared and with whom?** Addresses and coordinates of individual locations cannot be released without Confidentiality Agreements. DSG access data through RADAR or directly from York Stats. **Contact details for data source queries:** Agricultural Survey England: Farming-statistics@defra.gov.uk Agricultural Survey Wales: Stats.agric@wales.gov.uk Agricultural Survey Scotland: agric.stats@scotland.gov.uk ScotEID Livestock Traceability - support@scoteid.com Freedom of Information (FOI), Environmental Information Regulations (EIR) and Subject Access requests - enquiries@apha.gov.uk