# Livestock Demographic Data Group:

# Sheep population report

**Livestock population density maps for Great Britain using December 2022/January 2023 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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| Data source | Sheep and Goat Inventory: Rapid Analysis and Detection of Animal related Risk (RADAR) data warehouse for England and Wales and ScotEID for Scotland. |
| Data year | Winter 2022/23 (Sheep holdings on 1st December 2022 for England and Scotland, and 1st January 2023 for Wales) |

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# Contents

# Who are these reports for and what is their purpose?

These reports are suitable for use in animal health and welfare policy work or by anyone who requires an estimate of the distribution and size of the sheep population at Great Britain (GB) level. This type of population level information is often required to provide official statistical returns to the World Organisation for Animal Health (WOAH), assess the economic or social impact of particular animal health policies, for contingency, disease monitoring/control and resource planning, or to provide evidence to trading partners.

# 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 show the density of animals (Figure 1) and the density of holdings (Figure 2). The estimated number of holdings and number of sheep per country is shown in Table 1.

A livestock holding is defined as the land and buildings used to keep livestock. Each holding has a unique County Parish Holding (CPH). A livestock business can have more than one holding, which can include permanent holdings (used for more than one year) and temporary holdings (used for less than one year).

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

The data used are obtained from the annual Sheep and Goat inventory, which is carried out during the winter, and gathers data on the number of sheep and/or goats kept per holding. Most lambs are born in the spring, and then reared and sent for slaughter in the autumn. Therefore, the winter inventory represents the adult breeding flock and only the lambs that are kept for breeding or fattening. Although the number of sheep is higher in the summer due to the annual lamb crop, the spatial distribution of sheep and sheep holdings is similar in winter and summer.

# What do the data not show about the population?

The data from the annual Sheep and Goat Inventory do not include the majority of lambs born during the previous year, because most lambs are born in the spring, after the inventory has taken place in December/January and are slaughtered prior to the next inventory.

According to the June 2022 Agricultural Survey of a sample of commercial farms in GB, the total number of sheep and lambs in June 2022 was 31.03 million, of which 15.38 million were lambs (49.6%) (Livestock populations in the United Kingdom - GOV.UK (www.gov.uk). This indicates that the GB sheep population decreased by approximately 48% between summer 2022 and winter 2022/23. This difference was mainly due to the June 2022 survey including the spring lamb crop, many of which were slaughtered before the 2022/23 winter inventory.

# How accurate are the data?

There are important assumptions and uncertainties with these estimates, which the user should take into consideration. Limitations of the dataset are discussed in detail in the data 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 each classified to different scales and units 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. All sheep and goat keepers are required to register their holding and it is a legal requirement to complete the annual sheep and goat inventory. This is described in the data quality statement. The results are summarised in Table 1 and visualised in Figures 1 and 2.

Questionnaires were sent to 106,861 holdings in GB that were previously recorded as keeping sheep and/or goats. The questionnaire was completed by 82,248 respondents, giving an overall return rate of 77.0%. From the survey responses, there were 66,799 holdings that were keeping sheep[1].

For England, the questionnaire was sent to 72,726 holdings, and responses were received from 55,100 respondents (75.8%): there were 38,931 holdings keeping sheep.

For Scotland, the questionnaire was sent to 16,577 holdings, responses were received from 13,335 respondents (80.4%): there were 14,741 holdings keeping sheep[1].

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[1] Note that some respondents reported keeping sheep and/or goats at more than one holding (CPH).

For Wales, the questionnaire was sent to 17,558 holdings. The total number of responses received was 13,813 (78.7%): 13,127 holdings were keeping sheep.

The data are therefore derived from the 66,799 sheep holdings that returned 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, but assuming that many non-responders are no longer keeping sheep or goats, any underestimate in number of holdings and number of sheep is likely to be small.

The sheep and goat inventory collects data on the number of animals kept on 1st December for England and Scotland, and on 1st January for Wales. It is not expected that the collection of data for England and Scotland one month earlier than for Wales would have much effect on the data.

# 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 aid 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).
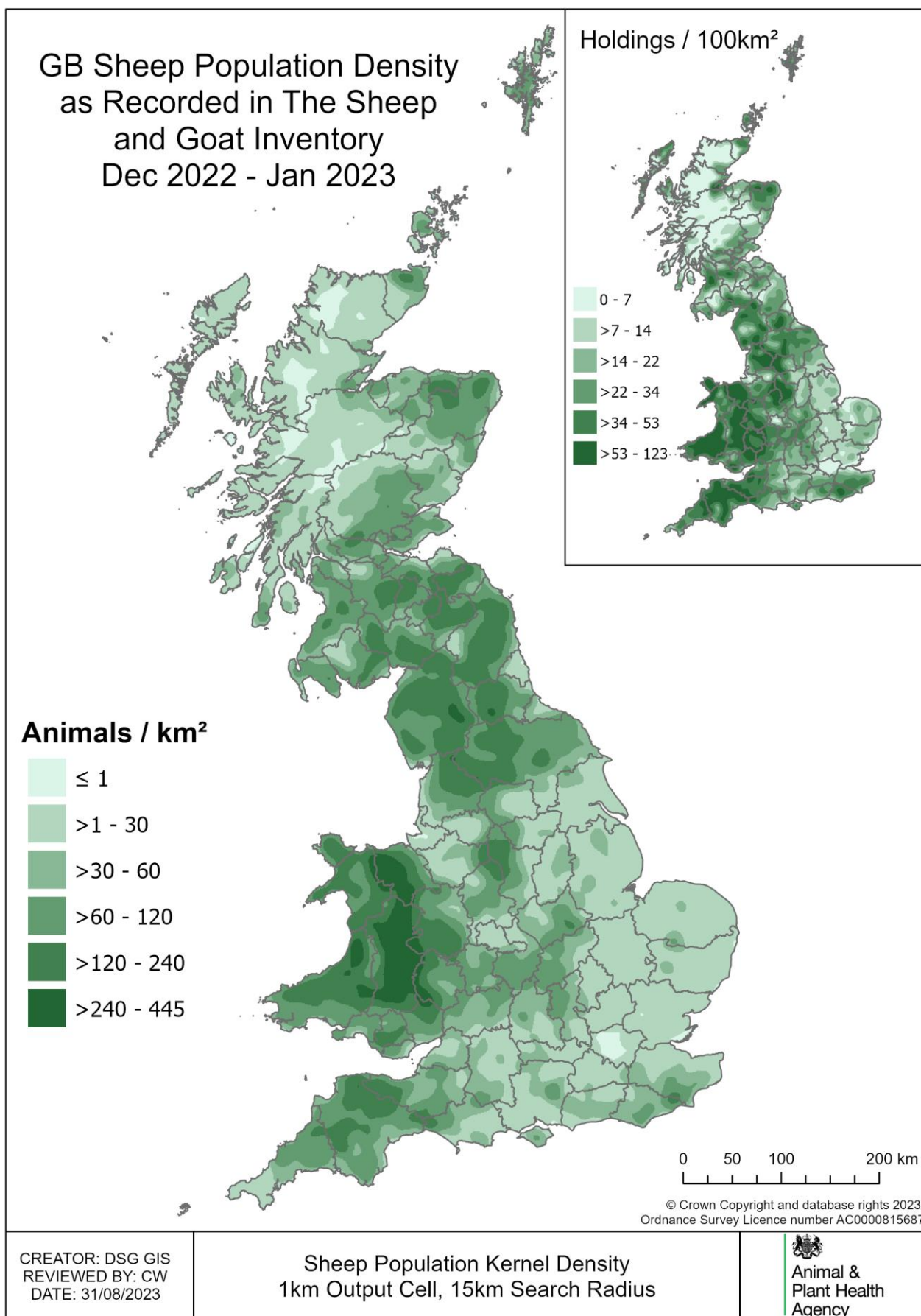
**Figure 1 Sheep population density in GB (Sheep and Goat Inventory Dec 2022/Jan 2023)**

GB Sheep Holding Density
as Recorded in The Sheep
and Goat Inventory
Dec 2022 - Jan 2023

Animal / km²

≤ 1
>1 - 30
>30 - 60
>60 - 120
>120 - 240
>240 - 445

Holdings / 100km²

0 - 7
>7 - 14
>14 - 22
>22 - 34
>34 - 53
>53 - 123

0    50    100         200 km

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CREATOR: DSG GIS
REVIEWED BY: CW
DATE: 31/08/2023

Sheep Holding Kernel Density
1km Output Cell, 15km Search Radius
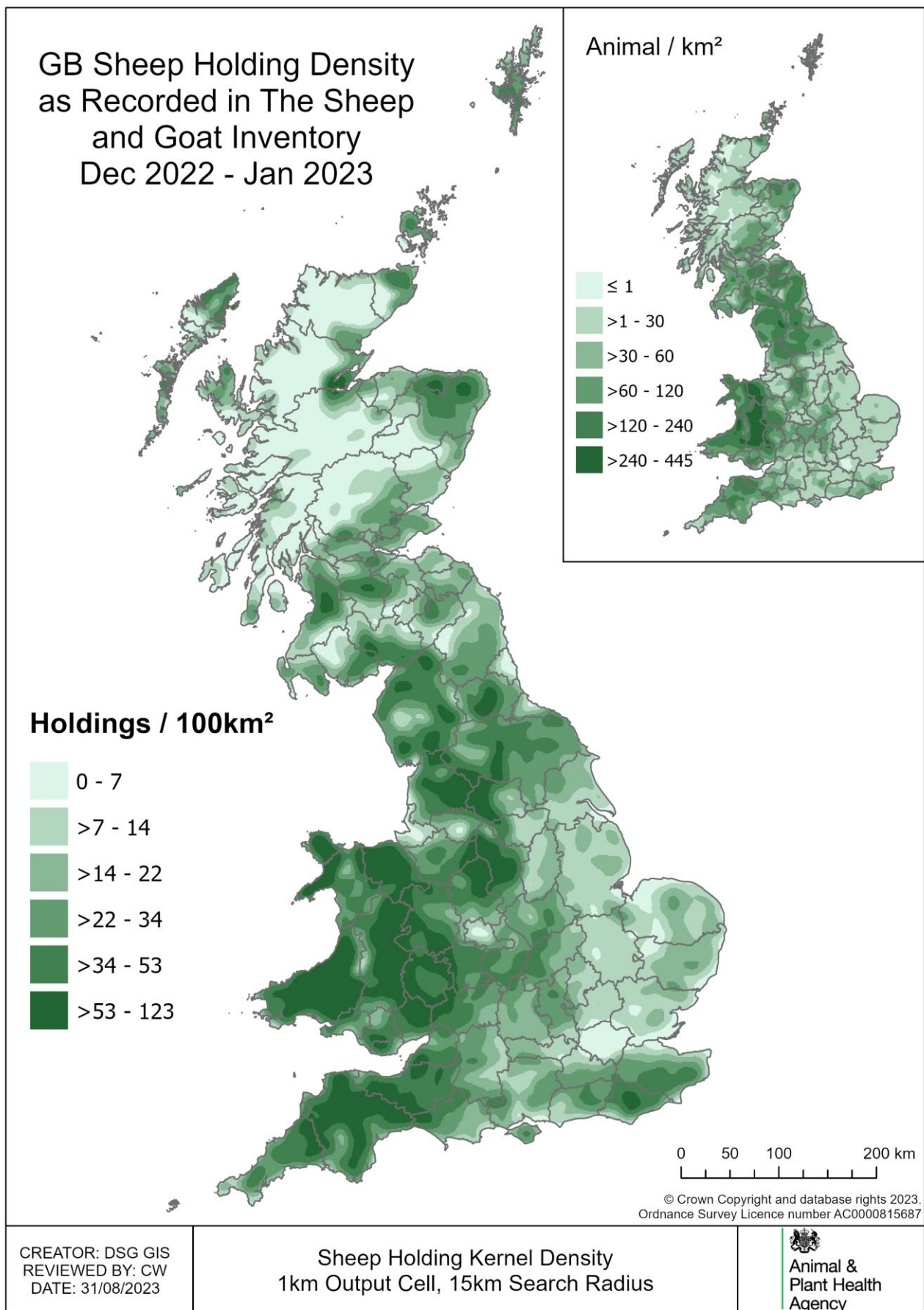
Animal &
Plant Health
Agency

**Figure 2 Sheep holding density in GB (Sheep and Goat Inventory Dec 2022/Jan 2023)**

**Table 1: Number of sheep holdings and number of sheep by country in GB, Dec 2021/Jan 2022 and Dec 2022/Jan 2023.** The number of sheep holdings and number of sheep per county in Dec 2022/Jan 2023 is provided in [Annex 2](#).

| Country | Number of sheep holdings | | | Number of sheep | | |
|---|---|---|---|---|---|---|
| | Dec 2021/Jan 2022 | Dec 2022/Jan 2023 | % Change | Dec 2021/Jan 2022 | Dec 2022/Jan 2023 | % Change |
| ENGLAND | 40,148 | 38,931 | -3.03% | 7,535,523 | 7,987,032 | 5.99% |
| SCOTLAND | 14,026 | 14,741 | 5.10% | 4,034,032 | 4,180,606 | 3.63% |
| WALES | 11,463 | 13,127 | 14.52% | 3,928,139 | 4,002,101 | 1.88% |
| GB TOTAL | 65,637 | 66,799 | 1.77% | 15,497,694 | 16,169,739 | 4.34% |

# Acknowledgements

# 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 (October 2023)

## 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 for England and Wales and directly from the Scottish government for Scotland.

The Sheep and Goat inventory 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 are collected once a year (1st December for England and Scotland, and 1st January for Wales) by means of a questionnaire which is sent to every registered sheep and goat holding in GB, and, for England, additional holdings recorded in the Animal Reporting and Movement Service (ARAMS) and in Sam (APHA customer database). The questionnaire requests the number of sheep and/or goats kept per holding. This gives a winter count of the population. For the winter 2022/23 inventory there was a response rate of 80.4% for Scotland, 75.8% for England, and 78.7% for Wales.

The Agricultural Survey was also considered as a source of data. These data are collected in the summer months and so include lambs born in the spring and therefore show a much larger population than in the Sheep and Goat inventory. However, this survey only collects data on larger agricultural holdings and not on smaller holdings. It was therefore decided that the sheep and goat inventory gave a better picture of all holdings in Great Britain, but the agricultural survey could be used if a summer count was required. In general, 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 of data, but this only shows movements of batches of animals and not individual counts and so it was decided this was not suitable.

| Category<br>*[definition]* | Quality description |
|---|---|
| **Relevance of data**<br><br>*[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).<br><br>**Temporal coverage:** The data presented are for December 1st, 2022 (England and Scotland) and January 1st, 2023 (Wales). The data were accessed in August 2023.<br><br>**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**<br><br><br>*[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 Scotland, and January 1st for Wales.<br><br>**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').<br><br>**Data reference period:** The data are a snapshot at the date of the survey.<br><br>**How often are the data updated?** Data are updated annually. |
| **Accuracy and precision**<br><br><br>*[extent of data error and bias and how well data portrays reality]* | **How were the data collected?** Questionnaires are sent once a year by post or by email to all holdings that have registered or are recorded as keeping sheep or goats.<br><br>**Sample & collection size:** All holdings registered or recorded as keeping sheep or goats are sent a questionnaire, so the survey is intended to be a full census of all known potential sheep holdings. It is not known how many other holdings are keeping sheep that have not registered or been recorded in the England Livestock Information Service (LIS, previously ARAMS), ScotEID, EIDCymru or Sam. The counts of holdings and number of sheep are obtained from all the holdings that returned the inventory form.<br><br>**Further information on rules for registering a holding where sheep and goats are kept:**<br><br>Sheep and goat keepers: register your holding and flock or herd - |

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|---|---|
| | <br><br>**What steps have been taken to minimise processing errors?**<br>The data collected through the survey are subject to manual validation to check the data accuracy. Not all data that fail validation can be corrected/confirmed as the survey team cannot always get in contact with the keeper. There are several 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.<br><br>**What are the response rates?** Response rates for the surveys conducted in December 2022 and January 2023 were 75.8% for England, 80.4% for Scotland and 78.7% for Wales.<br><br>**Are any parts of the population unaccounted for in the data collection?** The Defra Statistics Team did not receive returns from around 24.2% of holdings in England, 19.6% of holdings in Scotland and 21.3% holdings in Wales to which the questionnaires were sent. However, it is not known whether non-responders represent particular parts of the population. There may also be holdings that are not registered or recorded, and therefore did not receive the inventory form. In order to minimise the number of holdings not represented, information about the annual inventory and how to access the questionnaire is shared through various social media alerts.<br><br>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<br><br>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**<br><br><br>[*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.<br><br>**Other dataset comparability:** The annual Sheep and Goat Inventory, carried out in the winter, can be compared with the sheep population data collected during the Agricultural Survey, which is a sample survey of commercial flocks carried out in the summer and therefore also includes lamb populations. There was an approximately 46% decrease in the estimated sheep population in England, an approximately 38% decrease in Scotland, and an |

| | approximately 57% decrease in Wales, between the June 2022 Agricultural Census and the population in this report, which can mainly be attributed to the majority of the spring lamb crop being slaughtered before the winter inventory is carried out.

The AMLS holds movement data, which can compare information on holding locations and relative sizes. However, both datasets have a difference in data capture, as does data held within Sam. |
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| **Coherence**<br><br>[*degree to which data can be or have been merged with other data sources*] | **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 list of keepers contacted in connection with their annual inventory obligation is derived from the list of holdings statutorily maintained by APHA for England, Scottish government and Welsh government. Returns from those keepers who declare they are no longer keeping sheep or goats are used to update that list, and in turn update subsequent inventory-gathering exercises.<br><br>**Have any real-world events impacted on the data since the previous release?** No.<br><br>**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 have been used for total population and the AMLS for total holdings.<br><br>**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**<br><br>[*how well the data are understood and utilised appropriately*] | **Is there a particular context that these data need to be considered within?** This is a winter survey and as sheep production is highly seasonal the population will be much higher during the summer, post lambing.<br><br>**What other information is available to help users better understand this data source?** The questionnaires used to collect the data can be viewed at Sheep and goat keepers: complete your annual inventory - GOV.UK (www.gov.uk).<br><br>**Are there any ambiguous or technical terms that may need further explanation?** No. |

| Accessibility<br><br>[*availability of relevant information and access to these 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 Scottish government.<br><br>**Contact details for data source queries:**<br><br>Agricultural Survey England: Farming-statistics@defra.gov.uk<br><br>Agricultural Survey Wales: Stats.agric@wales.gov.uk<br><br>Agricultural Survey Scotland: agric.stats@scotland.gov.uk<br><br>ScotEID Livestock Traceability - support@scoteid.com<br><br>Freedom of Information (FOI), Environmental Information Regulations (EIR) and Subject Access requests - enquiries@apha.gov.uk |
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# Annex 2: Number of sheep holdings and number of sheep per county

Results of GB Sheep and Goat Inventory, December 2022/January 2023.

| Country | County | Number of sheep holdings | Number of sheep |
|---------|--------|--------------------------|-----------------|
| ENGLAND | AVON | 572 | 46177 |
| | BEDFORDSHIRE | 181 | 19756 |
| | BERKSHIRE | 174 | 25373 |
| | BUCKINGHAMSHIRE | 468 | 100830 |
| | CAMBRIDGESHIRE | 363 | 25363 |
| | CHESHIRE | 827 | 102623 |
| | CLEVELAND | 99 | 18801 |
| | CORNWALL AND ISLES OF SCILLY | 1523 | 248270 |
| | CUMBRIA | 2771 | 1037403 |
| | DERBYSHIRE | 1278 | 197852 |
| | DEVONSHIRE | 3576 | 761671 |
| | DORSET | 849 | 129571 |
| | DURHAM | 908 | 300442 |
| | EAST SUSSEX | 739 | 115376 |
| | ESSEX | 423 | 22148 |
| | GLOUCESTERSHIRE | 1026 | 145773 |
| | GREATER LONDON | 64 | 3370 |
| | GREATER MANCHESTER | 302 | 31396 |
| | HAMPSHIRE | 782 | 90969 |
| | HEREFORDSHIRE | 1214 | 288804 |

| Country | County | Number of sheep holdings | Number of sheep |
|---------|--------|--------------------------|-----------------|
| | HERTFORDSHIRE | 196 | 14144 |
| | HUMBERSIDE | 579 | 59161 |
| | ISLE OF WIGHT | 152 | 22679 |
| | KENT | 1045 | 141842 |
| | LANCASHIRE | 1532 | 345145 |
| | LEICESTERSHIRE | 670 | 148783 |
| | LINCOLNSHIRE | 762 | 113722 |
| | MERSEYSIDE | 57 | 2440 |
| | NORFOLK | 691 | 73757 |
| | NORTH YORKSHIRE | 3000 | 910577 |
| | NORTHAMPTONSHIRE | 602 | 132048 |
| | NORTHUMBERLAND | 1004 | 636227 |
| | NOTTINGHAMSHIRE | 310 | 47677 |
| | OXFORDSHIRE | 538 | 87902 |
| | SHROPSHIRE | 1645 | 428295 |
| | SOMERSET | 1767 | 293072 |
| | SOUTH YORKSHIRE | 311 | 49360 |
| | STAFFORDSHIRE | 1256 | 170645 |
| | SUFFOLK | 574 | 50020 |
| | SURREY | 359 | 33178 |
| | TYNE & WEAR | 47 | 5677 |
| | WARWICKSHIRE | 608 | 120062 |
| | WEST MIDLANDS | 103 | 13230 |
| | WEST SUSSEX | 471 | 63814 |

| Country | County | Number of sheep holdings | Number of sheep |
|---|---|---|---|
| | WEST YORKSHIRE | 915 | 88624 |
| | WILTSHIRE | 772 | 107586 |
| | WORCESTERSHIRE | 826 | 115397 |
| SCOTLAND | ABERDEENSHIRE | 1303 | 374823 |
| | ANGUS | 293 | 96361 |
| | ARGYLL | 853 | 239457 |
| | AYRSHIRE | 843 | 253805 |
| | BANFFSHIRE | 444 | 142387 |
| | BERWICKSHIRE | 252 | 138220 |
| | BUTE | 100 | 28933 |
| | CAITHNESS | 508 | 113902 |
| | CLACKMANNANSHIRE | 29 | 11702 |
| | DUMBARTONSHIRE | 91 | 30464 |
| | DUMFRIESSHIRE | 798 | 336072 |
| | EAST LOTHIAN | 121 | 52647 |
| | FIFE | 323 | 97470 |
| | INVERNESS-SHIRE | 1482 | 192465 |
| | KINCARDINESHIRE | 190 | 50820 |
| | KINROSS | 64 | 22263 |
| | KIRKCUDBRIGHT | 505 | 176756 |
| | LANARKSHIRE | 616 | 207293 |
| | MIDLOTHIAN & EDINBURGH | 171 | 92030 |
| | MORAY | 195 | 60675 |
| | NAIRN | 76 | 29308 |

| Country | County | Number of sheep holdings | Number of sheep |
|---------|--------|--------------------------|-----------------|
| | ORKNEY | 451 | 81478 |
| | PEEBLES | 160 | 109708 |
| | PERTH | 762 | 322288 |
| | RENFREW | 145 | 42997 |
| | ROSS & CROMARTY | 1502 | 123777 |
| | ROXBURGH | 383 | 235183 |
| | SELKIRK | 100 | 79902 |
| | SHETLAND | 759 | 139519 |
| | STIRLING | 272 | 95516 |
| | SUTHERLAND | 476 | 59694 |
| | WEST LOTHIAN | 97 | 22112 |
| | WIGTOWN | 377 | 120579 |
| WALES | CLWYD | 1682 | 550789 |
| | DYFED | 4366 | 933775 |
| | GWENT | 861 | 171506 |
| | GWYNEDD | 2227 | 682987 |
| | MID GLAMORGAN | 401 | 117643 |
| | POWYS | 3066 | 1443753 |
| | SOUTH GLAMORGAN | 194 | 29574 |
| | WEST GLAMORGAN | 330 | 72074 |