

Animal & Plant Health Agency

Livestock Demographic Data Group: Cattle population report Livestock population density maps for GB, using July 2022 data



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Who are these reports for?

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 cattle population at 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 Livestock Demographic Data Groups (LDDGs) were formed in January 2014 and comprise APHA representatives from data, epidemiology, species expert, and GIS work groups. The cattle LDDG is grateful to British Cattle Movement Service (BCMS), IBM and APHA Weybridge Data Systems Group (DSG) staff who handled the Cattle Tracing System (CTS) data and the APHA Rapid Analysis and Detection of Animal Related Risks (RADAR) data warehouse for their assistance in producing this report.

What do the data show about the population?

Table 1 shows the number of cattle and holdings in GB and by country within GB on 1st July 2022 and in the previous year for comparison. **Tables 2, 3 and 4** (<u>Annex 3</u>) show the number of cattle and holdings per county in England, Scotland, and Wales respectively on 1st July 2022 and 2021. The totals include cattle kept in abattoirs on the day of data extraction:

- The number of cattle holdings in GB identified in the dataset has slightly decreased, with a 2.5% reduction in total number of holdings from 2021 to 2022 (62,846 vs. 61,283, respectively). Of the three countries, England saw the largest reduction in the number of cattle holdings (2.7%), and in Scotland and Wales the number of cattle holdings reduced by 2.1% and 1.9% respectively in 2022 compared to 2021.
- On the other hand, the total number of cattle in GB has remained relatively constant (<1% increment in the total number of cattle in GB from 2021 to 2022). Of the three countries, in England the number of cattle increased by approximately 1%, whereas numbers in Scotland decreased by just over 1%. In Wales the number of cattle has remained consistent between 2021 and 2022. The data shown in Tables 1-4 were produced using the same method and same data source and are therefore directly comparable.

Table 1: Number of cattle holdings and number of cattle by country in GB, based on 1stJuly 2021 and 2022 records. The number of cattle holdings and number of cattle per county isprovided in Annex 3.

Country	Number of holdings			Number of cattle		
	2021	2022	% Change	2021	2022	% Change
ENGLAND	41,591	40,452	-2.7	5,089,442	5,135,928	0.9
SCOTLAND	10,803	10,574	-2.1	1,723,474	1,704,426	-1.1
WALES	10,452	10,257	-1.9	1,149,145	1,148,642	0.0
GB TOTAL	62,846	61,283	-2.5	7,962,061	7,988,996	0.3

Figures 1 and 2 show either the density of animals, with a smaller map to show how this compares with the density of holdings, or vice versa in a single timepoint, 1st July 2022. In contrast to other livestock species, there is little difference for cattle between the two distributions. Both the cattle population density and holding maps reflect distribution of the GB cattle industry:

- The greatest density of cattle population and holdings is generally on the west side of Great Britain; this includes Ayrshire, Dumfries & Galloway, northwest England, northwest Midlands, southwest Wales, and southwest England.
- The areas with the sparsest cattle population and holding densities also reflect general understanding of the cattle industry demographic; these include parts of northwest Scotland, parts of East Anglia, and large urban areas such as London.

As with **Figures 1 and 2**, **Figure 3** shows population densities across Great Britain. These however are split into beef and dairy cattle distributions and then combined as a single bivariate population density map, showing the spatial distribution of the beef and dairy populations across GB. For the purpose of this report, information on cattle breed purpose as defined in RADAR was used to define beef and dairy breed populations. There is significant overlap between holdings which have dairy breed cattle and those which have beef breed cattle. Due to this significant overlap, it was felt that a potential bivariate map of beef and dairy holdings for 2022, as had been created in previous years, was increasingly questionable and had lost its utility. As such this has not been created for 2022.

Separate beef and dairy population and holdings density maps can be seen in **Figures 4**, **5**, **6 and 7** in <u>Annex 2</u>. A beef holding was defined as a cattle holding with at least one beef breed animal present on the 1st of July 2022. Similarly, a dairy holding was defined as a cattle holding with at least one dairy breed cattle present on the 1st of July 2022.

As with the total cattle distributions, the highest densities of both beef and dairy population and holdings tend towards the west of Great Britain. Some differences in distribution between beef and dairy are seen, however. Areas with the highest dairy population density, for example in the southwest peninsula of England, Dyfed, northeast Wales, the northwest Midlands, Lancashire, Cumbria, Dumfries & Galloway, and Ayrshire, all coincide with either the highest or moderate densities of beef cattle. No areas of high dairy population density are coincident with low beef population density. Whereas, in Scotland, for example, Orkney, Caithness, Aberdeenshire, Banffshire, Berwickshire and Roxburgh all show areas of high (>50 cattle per km²) beef population density and low (0-10 cattle per km²) dairy population density. This can also be seen locally in northeast England, in Northumberland, Durham and North Yorkshire, as well as Buckinghamshire.



Figure 1: Cattle population density in GB (as recorded in CTS on 1st July 2022) with holding density inset.



Figure 2: Cattle holding density in GB (as recorded in CTS on 1st July 2022) with population density inset.



Figure 3: Bivariate map showing both Beef and Dairy population density (as recorded in CTS on 1st July 2022) in GB. Beef and dairy cattle defined according to breed purpose as defined in RADAR.

How accurate are the data?

The data are derived from the CTS by analysis of all the reported movements, birth, and death registrations of cattle on and off holdings in Great Britain on 1st July 2022. The output of this analysis is stored in 'RADAR', an APHA information management system; where location data are missing in the record due to subsequent updates, new location records have coordinates generated from the postcode of their address. Therefore, there can be a discrepancy between the 'RADAR' location and that provided originally through CTS; 88% of RADAR and CTS locations are within 2km, but notably 3% are > 20km apart. The supporting quality statement provides further detail on the limitations in the data (Annex 1).

What do the data not show?

The population dataset represents a single snapshot in time as recorded in CTS (on July 1st, 2022). It does not draw out the pattern of movements between cattle herds, or the effect of seasonal breeding on the number of young calves or seasonal grazing.

The representation of the cattle demographic by data from CTS is near complete, but not perfect. A small number of movements are not recorded, either due to non-compliance or are not required to be recorded. However, these are believed to not significantly impact the data presented.

There is uncertainty inherent in the information displayed. Limitations in the dataset are discussed in the supporting quality statement (<u>Annex 1</u>) and it is important that the user considers these in the context of their work. Similarly, population and holding density maps are classified to different scales and units; and due care must be taken regarding their interpretation.

How were the maps produced?

Figures 1 & 2 have been created using the kernel density function in *ArcGIS* software. This tool spatially distributes population information (the populations at holdings and their point locations), over a defined radius (15km radius 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 process¹. 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

¹ Pfeiffer, D. Spatial Analysis in Epidemiology, 2008. p47.

key. Note that the ArcGIS Kernel Density tool does not take into account edge effects², and as such density estimates in and around coastal areas may be underestimated. Such holdings are however incorporated into the Country and County figures shown in Tables 1, 2, 3 and 4, and <u>Annex 3</u>.

Comparison between the maps was optimised by assigning similar parameters between the species in this series of reports to those used in previous reports.

Figure 3 was also created using the kernel density function in *ArcGIS* software to create separate beef cattle and dairy cattle density surfaces. Contours of these surfaces were then extracted at the intervals shown on the maps, the contours were then merged into a single set of polygons using the union tool in ArcGIS. This allowed the values of both contour sets to be preserved as a series of overlapping polygons. These were then styled according to their dairy and beef values.

Annex 1: Data quality statement for cattle (July 2023)

Introduction

This data quality statement provides an overview of the quality of the data used to underpin the kernel density holding and livestock figures. 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 the source data

Data were supplied by the APHA's Data Systems Group (DSG) and sourced from the Rapid Analysis and Detection of Animal-related Risks (RADAR) data warehouse, the Cattle Tracing System (CTS) database and APHA's Sam database. The CTS dataset describes cattle movement, birth and death registration data, contributing to the overall cattle count and location data, within GB and is captured by the British Cattle Movement Service (BCMS).

Category [definition]	Quality description
Relevance of data	Spatial coverage: The data cover Great Britain.

² https://www.e-education.psu.edu/geog586/I5_p15.html

[degree to which data meets user	Temporal coverage: The data are representative of July 1st, 2022, as recorded in CTS and were accessed via RADAR in June 2023.					
needs in terms of currency, geographical coverage, content and detail]	Key data items available: The dataset includes births, deaths, and movements for registered cattle. It can provide the number and location of cattle at any one point in time based on these movement records. It also includes data on breed and sex. Information on breed purpose (i.e., beef or dairy) available in RADAR was used to define cattle population as beef or dairy, and to produce the beef and dairy figures behind the bivariate population map seen in Figures 3. A dual-purpose breed was also identified in the data. This represented around 3% of overall cattle and was included in the total cattle maps but was excluded from the beef and dairy bivariate map in Figure 3.					
Timeliness [the degree to which data represent reality from the required	How often are the data collected? A continuous stream of on-line reports or completed movement forms are submitted to the British Cattle Movement Service (BCMS) by farmers and entered into CTS. Location co-ordinates of holdings are uploaded to CTS from APHA's operational database called SAM only once per holding. Data are uploaded to RADAR monthly.					
time point]	When do the data become available? Data become available in RADAR up to one month after collection.					
	Data reference period: The database is fed continuously but the population data are a snapshot extracted from July 1st, 2022. This month was chosen because the cattle population drops slightly over winter but is most stable during summer. Also, 1st of July has been used historically and therefore allows comparison of patterns with the previous cattle population reports.					
	How often are the data updated? Movements are recorded online directly to CTS or are reported by phone or by post to BCMS within the 3-day legal reporting period. Holding location coordinates for a CPH are not updated in CTS, and if SAM does not have a record of that holding no coordinates are assigned. Gaps in the initial upload of SAM location coordinates into CTS are filled by the RADAR 'best co-ordinates' algorithm which imputes the location from other data including the address, and has done this regardless of data missing initially from Sam. This though ceased for new locations from around the end of 2017 and so the coordinates are now generated outside of RADAR from the postcode given for the address. If that does not exist, it is taken from information given in SAM for the holding. No location is assigned if that still fails to determine a coordinate, but					

	these are few, only six holdings in the 2022 report, representing
	0.001% of the total number of animals.
Accuracy and precision	How were the data collected? Cattle population estimates on each holding are calculated from cattle movement information. Farmers and other cattle keepers, i.e., market operators, agricultural shows
[extent of data error and bias and how well data portrays reality]	and abattoirs, are legally required to submit completed records of cattle movements online or via forms to BCMS. Separate movement forms are submitted as movements off and movements on; these are 'paired' by algorithm prior to being made available, i.e., the from and to herd forms are combined into a single record. 'New' keepers should register with APHA before reporting moves to BCMS. However, occasionally they can report moves without having done so, in which case location data will be missing from CTS. Location coordinates are assigned to a holding from SAM when a submitted form has a new location, but location data will be missing if SAM has no record at the time. SAM amendments to the location are not usually fed back to BCMS, which is because BCMS does not actively use the holding geolocation, only the physical address.
	Sample & collection size: There are approximately 60,748 CPH records within the CTS database that had at least one bovine animal on the holding, as of 1st July 2022. A holding is defined as any location with cattle on 1st July 2022 (i.e., production holdings, markets, shows, slaughterhouses, etc.). A holding can have one or more cattle herds. There are approximately 768,000 ³ movement records per month (including movements to slaughter but not the additional death movement acknowledging the slaughter itself) which are used to calculate changes in the cattle population on each holding.
	What steps have been taken to minimise processing errors? DSG monitors the monthly CTS upload by checking that the file is complete and holds expected data. Checks are made monthly by IBM to ensure the data have loaded into RADAR correctly. BCMS investigate and resolve any cattle movements which appear to be either suspicious or inaccurate.
	What are the non-reporting or non-response rates? It has been assumed that very few cattle keepers fail to report cattle movements, births and death. It is a legal requirement to do so. Unrecorded movements may lead to incomplete data, so inferred

³ This presents the median monthly number of movements between 2018 and 2022 (varies a lot from month to month but the median doesn't vary over 10 years)

	movements are calculated when the animal next appears on a movement submission. These movements are unlikely to impact the population counts significantly.
	More precise and accurate data resulting from changes to CPH and movement reporting rules. Throughout GB, 'links' which previously allowed movements not to be reported between paired holdings have been phased out. In England and Wales, new rules mean that larger businesses, with cattle kept at different locations, must register them separately and report moves. Also, all businesses keeping cattle at further locations on a seasonal basis must report moves if the distance is significant (using tCPHs; if within ten miles the land-use can rather be reflected as a Temporary Land Association, TLA, and moves are not reported). As a result, the total cattle population count is unaffected, but there is greater accuracy of cattle location data. In Scotland TLAs and tCPHs are not used; rather movements within businesses are captured via "Scot moves" on its ScotEID system. However, these data do not feed to CTS nor to RADAR and so do not feature in this report.
Comparability	Within dataset comparability: Routine checks show that data extracted at different times are highly comparable.
can be compared with data taken from the same dataset and with similar data from other sources]	Other dataset comparability: The CTS data appear to be the most accurate for placing cattle in a place at a point in time. SAM and RADAR may have more up to date information on location coordinates. This will have minimal impact on county level summaries or kernel density smoothed maps.
Coherence [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? We are not aware of any change in collection methods during recent years other than already mentioned changes to how "links" between paired holdings have previously been reported but assume minimal bias has been caused. Current location details may be different from when location was first recorded but should still be of similar geographic location.
	Have any real-world events impacted on the data since the previous release? None have been identified.
	What other data sources are these data comparable with? Location data are comparable between CTS, SAM and RADAR. There are not thought to be any other datasets that would hold information on cattle movements.

Interpretability [how well the data is understood and utilised appropriately]	Is there a particular context that these data need to be considered within? This dataset can be used to obtain information regarding animal movements and animal population counts. The cattle population peaks during the summer and dips during the winter. These data are from the summer peak (1 st of July 2022). As registration of movements is legally enforced, we expect the data to be a near complete representation of cattle within the agricultural industry.
	What other information is available to help users better understand this data source? We have documentation of what the tables and data represent. IBM have technical documentation for the compilation of the data.
	Are there any ambiguous or technical terms that may need further explanation? A holding is defined as any location with cattle on 1 st July 2022 (i.e., agricultural holdings, markets, shows, slaughterhouses, etc.). A holding can have one or more cattle herds. The data used for this report are at a holding level and care should be taken when comparing these data with other sources that report data at herd level.
A	
[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. However, summary cattle movement outputs and aggregated data can be shared. The dataset is very large, so provision of individual records would not be easy even with Confidentiality Agreements in place. Aggregated data are a better option. Data are stored within SQL (Structured Query Language) tables on secure servers.
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Annex 2: Additional maps



Figure 4: Beef population density in GB with holding density inset.



Figure 5: Beef holding density in GB with population density inset.



Figure 6: Dairy population density in GB with holding density inset.



Figure 7: Dairy holding density in GB with population density inset.

Annex 3: Number of cattle holdings and number of cattle per county

Table 2: Total number of cattle holdings and number of cattle per county forEngland, based on July 2022 records.Data for counties with 6 or fewer holdings havebeen excluded from this table for data protection reasons.

	Number of		%	Number of		%
County	holdi	ings	change	cattle		change
County	2021	2022	from	2021	2022	from
	2021		2021	_0_1		2021
AVON	647	636	-1.7	75,975	77,216	1.6
BEDFORDSHIRE	151	147	-2.6	11,074	10,423	-5.9
BERKSHIRE	187	174	-7.0	16,413	15,877	-3.3
BUCKINGHAMSHIRE	428	406	-5.1	54,139	55,772	3.0
CAMBRIDGESHIRE	298	302	1.3	27,747	29,561	6.5
CHESHIRE	1,312	1,255	-4.3	233,060	233,283	0.1
CLEVELAND	131	125	-4.6	15,317	15,016	-2.0
CORNWALL	2,403	2,341	-2.6	318,836	319,662	0.3
CUMBRIA	2,922	2,884	-1.3	438,685	438,803	0.0
DERBYSHIRE	1,526	1,486	-2.6	167,850	167,946	0.1
DEVONSHIRE	4,074	3,986	-2.2	579,249	589,248	1.7
DORSET	1,005	969	-3.6	171,259	176,459	3.0
DURHAM	875	848	-3.1	87,394	87,840	0.5
EAST SUSSEX	516	511	-1.0	42,705	44,096	3.3
ESSEX	353	346	-2.0	27,945	28,177	0.8
GLOUCESTERSHIRE	913	896	-1.9	113,997	117,158	2.8
GREATER LONDON	60	59	-1.7	1,902	1,734	-8.8
GREATER MANCHESTER	405	388	-4.2	22,214	21,415	-3.6

	Number of		%	Number of		%
County	holdings		change	cattle		change
County	2021	2022	from	2021	2022	from
			2021			2021
HAMPSHIRE	724	712	-1.7	59,681	59,301	-0.6
HEREFORD	986	964	-2.2	111403	110,750	-0.6
HERTFORDSHIRE	204	190	-6.9	10,547	10,521	-0.2
HUMBERSIDE	658	636	-3.3	55,673	55,820	0.3
ISLE OF WIGHT	118	118	0.0	9,775	9,823	0.5
ISLES OF SCILLY	19	19	0.0	286	271	-5.2
KENT	586	579	-1.2	51,827	52,964	2.2
LANCASHIRE	1,764	1,723	-2.3	227,270	229,040	0.8
LEICESTERSHIRE	851	824	-3.2	111,615	110,261	-1.2
LINCOLNSHIRE	744	732	-1.6	80,599	80,039	-0.7
MERSEYSIDE	54	53	-1.9	4,776	4,784	0.2
NORFOLK	842	810	-3.8	72,771	72,357	-0.6
NORTH YORKSHIRE	3,085	3,013	-2.3	373,981	379,242	1.4
NORTHAMPTONSHIRE	489	472	-3.5	53,224	53,252	0.1
NORTHUMBERLAND	973	957	-1.6	139,851	139,888	0.0
NOTTINGHAMSHIRE	441	428	-2.9	43,144	44,082	2.2
OXFORDSHIRE	464	455	-1.9	61,370	62,679	2.1
SHROPSHIRE	1,734	1,656	-4.5	244,681	246,468	0.7
SOMERSET	2,028	1,966	-3.1	291,562	296,193	1.6
SOUTH YORKSHIRE	392	383	-2.3	33,650	34,566	2.7
STAFFORDSHIRE	1,817	1,755	-3.4	210,571	213,516	1.4
SUFFOLK	463	445	3.9	32,920	32,956	0.1

	Number of		%	Number of		%
County	holdings		change	cattle		change
County	2021	2022	from	2021	2022	from
			2021			2021
SURREY	305	294	-3.6	27,831	30,015	7.8
TYNE & WEAR	73	73	0.0	6,023	6,363	5.6
WARWICKSHIRE	521	511	-1.9	54,534	56,243	3.1
WEST MIDLANDS	83	71	-14.5	6,200	6,440	3.9
WEST SUSSEX	395	377	-4.6	38,519	38,389	-0.3
WEST YORKSHIRE	966	930	-3.7	66,219	65,673	-0.8
WILTSHIRE	977	938	-4.0	151,116	151,789	0.4
WORCESTERSHIRE	629	609	-3.2	52,062	52,557	1.0

Table 3: Total number of cattle holdings and number of cattle per county forScotland, based on July 2022 records. Data for counties with 6 or fewer holdings havebeen excluded from this table for data protection reasons.

	Number of		%	Num	per of	%
Country	holdings		change	cattle		change
County	2021	2022	from	2021	2022	from
			2021			2021
ABERDEENSHIRE	1,322	1,284	-2.9	215,155	202,436	-5.9
ANGUS	269	263	-2.2	41,973	41,183	-1.9
ARGYLL	623	610	-2.1	51,146	50,277	-1.7
AYRSHIRE	822	809	-1.6	176,319	177,607	0.7
BANFFSHIRE	391	381	-2.6	51,864	50,000	-3.6
BERWICKSHIRE	193	190	-1.6	59,292	60,396	1.9
BUTE	78	78	0.0	12,186	12,154	-0.3
CAITHNESS	379	374	-1.3	44,586	43,889	-1.6

	25	22	0 0	0 5 0 7	2 5 4 4	17
CLACKMANNANSHIRE	25	23	-8.0	2,587	2,544	-1.7
DUNBARTONSHIRE	82	82	0.0	11,259	11,217	-0.4
DUMFRIESSHIRE	679	670	-1.3	159,246	161,591	1.5
EAST LOTHIAN	85	77	-9.4	17,509	16,921	-3.4
FIFE	268	264	-1.5	52,756	52,488	-0.5
INVERNESS-SHIRE	864	847	-2.0	34,871	34,364	-1.5
KINCARDINESHIRE	174	174	0.0	40,095	38,875	-3.0
KINROSS	48	48	0.0	7,583	7,683	1.3
KIRKCUDBRIGHT	428	415	-3.0	133,601	133,657	0.0
LANARKSHIRE	570	554	-2.8	93,567	94,460	1.0
MIDLOTHIAN & EDINBURGH	122	115	-5.7	21,096	21,154	0.3
MORAY	135	132	-2.2	22,613	21,215	-6.2
NAIRN	46	43	-6.5	8,489	8,173	-3.7
ORKNEY	492	488	-0.8	78,117	77,027	-1.4
PEEBLES	99	96	-3.0	15,572	15,347	-1.4
PERTH	495	477	-3.6	61,910	61,490	-0.7
RENFREW	165	162	-1.8	25,388	25,424	0.1
ROSS & CROMARTY	501	488	-2.6	25,382	24,422	-3.8
ROXBURGH	254	250	-1.6	49,534	49,237	-0.6
SELKIRK	59	56	-5.1	10,427	10,149	-2.7
SHETLAND	157	153	-2.5	4,928	4,998	1.4
STIRLING	255	249	-2.4	37,456	37,332	-0.3
SUTHERLAND	218	218	0.0	7,499	7,129	-4.9
WEST LOTHIAN	77	74	-3.9	13,207	13,152	-0.4
WIGTOWNSHIRE	428	430	0.5	136,261	136,435	0.1

Table 4: Total number of cattle holdings and number of cattle per county for Wales,based on July 2022 records.Data for counties with 6 or fewer holdings have beenexcluded from this table for data protection reasons.

County	Number of		%	Number of		%
	holdings		change	cattle		change
	2021	2022	from	2021	2022	from
			2021			2021
CLWYD	1,452	1,411	-2.8	184,749	183,474	-0.7
DYFED	3,723	3,630	-2.5	491,905	491,343	-0.1
GWENT	649	626	-3.5	59,761	60,450	1.2
GWYNEDD	1,885	1,889	0.2	177,113	175,766	-0.8
MID GLAMORGAN	333	326	-2.1	20,748	20,854	0.5
POWYS	1,982	1,960	-1.1	180,324	182,698	1.3
SOUTH GLAMORGAN	137	134	-2.2	17,044	16,837	-1.2
WEST GLAMORGAN	291	281	-3.4	17,501	17,220	-1.6