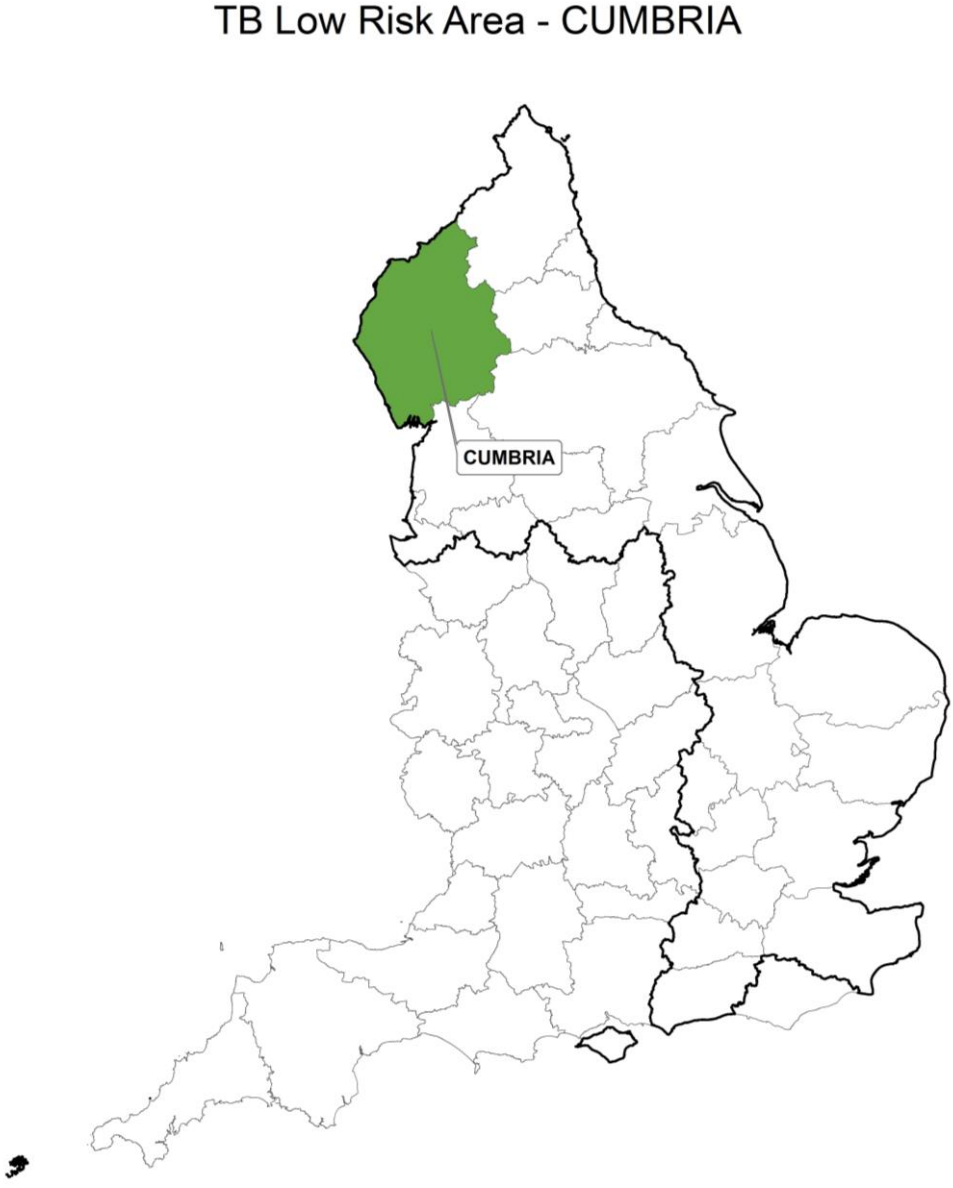
Animal & Plant Health Agency

Year-end descriptive epidemiology report:

Bovine TB in the Low Risk Area of England

County coverage: Cumbria

Year-end report for: 2019



Contents

Executive summary

Reporting area

Cumbria is part of the Low Risk Area (LRA) that was established in 2013. The following year, the bovine tuberculosis (TB) surveillance strategy for this area was incorporated into the Government's strategy to achieve Officially Tuberculosis Free (OTF) status for England by 2038. Overall the LRA has a very low and stable incidence of infected herds. This end of year report describes bovine TB in Cumbria.

Local cattle industry

Cumbria has over 400,000 cattle in approximately 3,000 herds, split between similar numbers of beef and dairy units, and ranging from very small family holdings to large commercial units. Most herds are managed in a traditional way, housed in winter and grazed in summer. There are several livestock markets, facilitating a significant number of movements in and out of the county, also between Scotland and Northern Ireland. The county has one Licensed Finishing Unit.

New incidents of TB

In 2019 there were 29 new TB incidents in Cumbria, of which five were lesion and/or culture positive (i.e. OTF status withdrawn or OTF-W) cases. This represents a small increase in the total annual number of new incidents, in comparison with the 27 cases that occurred during 2018, however the number of OTF-W incidents reduced by four.

Potential or confirmed TB hotspot areas

Currently there are two active hotspot areas in Cumbria.

- East Cumbria confirmed hotspot area (HS21): Established in 2016. Enhanced measures for TB surveillance in both cattle and wildlife (badgers and wild deer) were put in place after the detection of three *Mycobacterium bovis* (*M. bovis*) positive badgers found dead in 2017. There have been six OTF-S incidents during the reporting period and at the end of 2019 there were no herds under restrictions due to a TB incident in this area. The second year of licensed badger culling took place in much of the HS21 area during the autumn of 2019.
- South Cumbria potential hotspot area (HS26): It was created in the summer of 2019 after the emergence of a cluster of cases in the South of the county. Wildlife surveillance is being carried out, but the number of submissions has been very low to date.

Unusual TB incidents

An OTF-W incident from 2018 became persistent during the reporting period, and has now resolved after the removal of a significant number of test reactor animals. Another incident in a large dairy herd resulted in 158 cattle being slaughtered for TB control purposes. No other remarkable incidents occurred during 2019.

Suspected sources and risk pathways for TB infection

Most cases in 2019 appeared to be related to wildlife, locally purchased cattle or of undetermined origin due to the inability to isolate *Mycobacterium bovis* in laboratory cultures (and hence lack of genotyping information) in OTF-S cases (24 of the 29 new incidents). Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement for England 2019.

Disclosing tests

The majority of incidents in Cumbria were detected via enhanced surveillance TB tests such as radial, pre-movement, or hotspot testing. A small proportion were disclosed through routine testing.

Reactor numbers

A total of 190 cattle were removed for TB control purposes during 2019. Of these, 77 (41%) were skin reactors and 113 (59%) interferon gamma (IFN-γ) test positive animals. This represents a reduction of nearly 100 animals compared to the 2018 figures.

Risks to the reporting area

The risk of TB incursions into Cumbria from the adjoining LRA and Scottish counties is assessed as low. The most likely risks come from movements of cattle into the county from higher TB incidence areas of the UK, either directly from farm-to-farm sales or via animal gatherings. These can be mitigated by pre- and post-movement testing where applicable, but cattle purchasing practices are not yet ideal.

Risks posed by the reporting area

Cumbrian areas of higher disease incidence are in the East and South where the hotspots are located. The enhanced TB surveillance and control measures in force in both these areas reduces the risk of spreading disease via cattle moving out of the county. Therefore, the overall risk to neighbouring counties remains low.

Forward look

In order to further reduce TB incidence and maintain the low TB risk status of Cumbria, enhanced surveillance measures need to be continued, together with the implementation of safer cattle purchasing policies, wildlife surveillance around unexplained clusters of cattle TB incidents and better biosecurity in herd management.

Introduction

This report describes the level of bovine tuberculosis in cattle herds in Cumbria in 2019. Bovine TB is caused by the bacterium *Mycobacterium bovis* (*M. bovis*), and will subsequently be referred to as TB. This report explores the frequency and geographical distribution of TB in cattle herds. It examines what is likely to be driving TB in Cumbria, and the risks the disease in this county may pose to neighbouring cattle. Although other sources may refer to TB 'breakdown(s)', this report will use the term 'incident(s)' throughout. This report is intended for individuals involved in the control of TB, both in the local area and nationally. This includes, but is not limited to: farmers, veterinarians, policy makers and the scientific community.

In 2014, the Government published its Strategy to achieve Officially TB Free (OTF) status for England by 2038. A key action was to recognise the different amount of TB in different parts of the country and to vary the approach to control accordingly. To this end, three management areas were established (Appendix 1). Cumbria forms part of the LRA. Overall, the LRA has a very low and stable incidence of infected herds. The current strategy seeks to rapidly control infection when it arises through high sensitivity testing of affected herds and temporarily enhanced local surveillance (radial and hotspot testing). Compulsory pre- and post-movement testing of cattle entering the LRA from higher risk areas of the UK is also performed to reduce the risk of TB introduction. The aim is to preserve the favourable disease status of this county so that it can be declared OTF as soon as possible.

Cattle industry

Cumbria has over 400,000 cattle in approximately 3,000 herds, with similar numbers of beef and dairy businesses, and some mixed herds. Most herds are located out with the Lake District National Park, where the land is most suitable, mostly to the North and East of the county. Also a proportion of them are situated towards the west coast and the Lake District Peninsulas.

As presented in Figure 1, the size of the herds ranges from family holdings with a small number of animals to large dairy herds with over 1000 head.

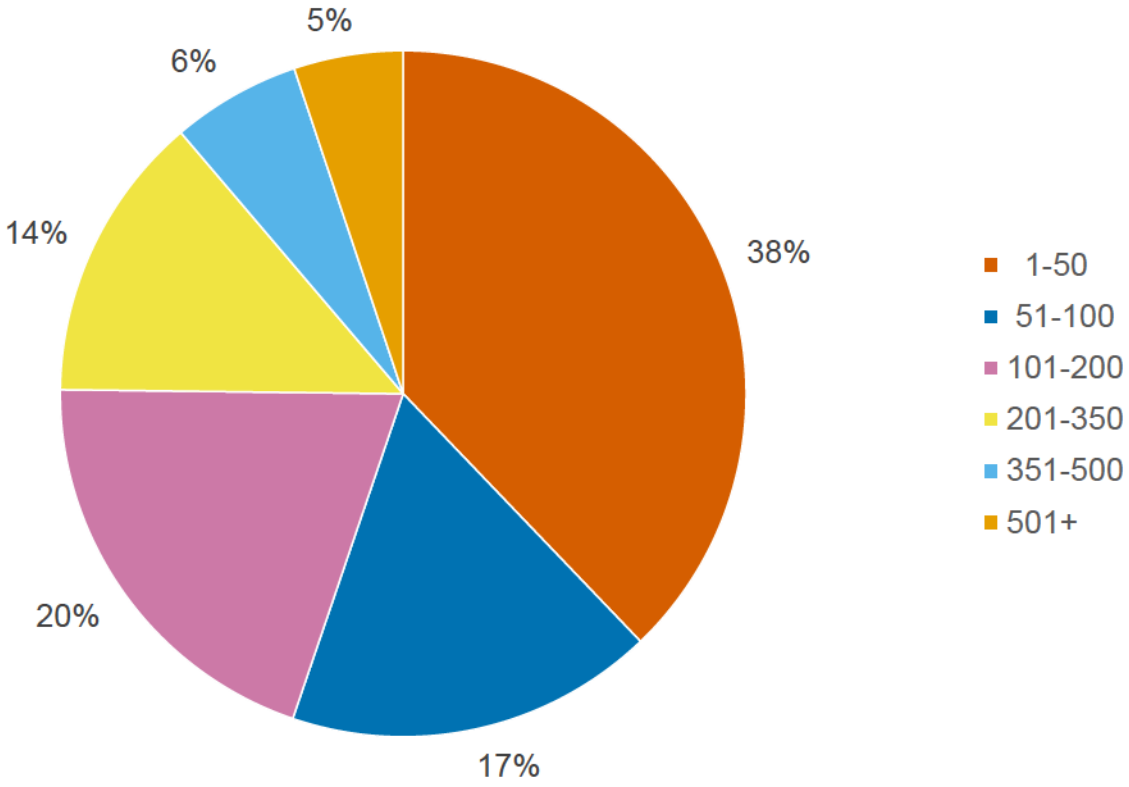


Figure 1: Proportion of cattle holdings in Cumbria, by herd size in 2019 (n=2914).

Grazing practices and common land

The most common practice is to house the animals during the winter months and graze in summer from April-May to October. There are many areas of common land across the county, some of which require a number of animals grazing every year for the farmers to receive subsidy payments.

Cattle movement practices

Compulsory pre-movement TB testing (PRMT) of cattle from higher risk herds was established as a precautionary measure in March 2006 to mitigate the risk of spreading TB through movements of infected cattle from these areas. It currently applies to all cattle over 42 days of age that are moved out of herds on an annual or six-monthly testing frequency. In recent years, Cumbrian farmers are becoming increasingly aware of the risk of buying cattle from areas of high and intermediate incidence of bovine TB. Yet many herd owners who need to purchase cattle source them locally via livestock markets.

There is still a considerable number of cattle moving into Cumbrian herds every year. These movements are mostly from other holdings within the county and other parts of the LRA. However, movements from the High Risk and Edge Areas of England and Wales are still happening, and many of these movements are through markets. Purchasers of these animals are not necessarily aware of their origin until after animals have been bought, although they

will have been pre-movement tested for TB with negative results and, since April 2016, require a post-movement skin test too. Owners of herds that buy in cattle for final finishing tend to be less cautious about the sources of their purchased cattle, and many of these cattle will be slaughtered prior to completion of their post-movement test.

There is an important movement of cattle from Cumbria into Scotland as well as a significant number of cattle from Northern Ireland and the Republic of Ireland entering the county, and generally ending up on beef finishing/fattening units. A number of pedigree breeding bulls from Northern Ireland also move onto Cumbrian farms.

Markets and abattoirs

There are nine livestock auctions in Cumbria and several collection centres, of which four gather fat cattle. These are used mostly to consign cattle directly to slaughter. There are some abattoirs for finished cattle although the main ones are in Lancashire and further South in England.

Finishing units

There is now one Licensed Finishing Unit (LFU) approved by APHA in Cumbria, which allows an outlet for finishing cattle from OTF herds, under strict biosecurity conditions. Cattle in LFUs must be sourced from unrestricted (OTF) herds and are subject to pre-movement testing when required. Currently, this unit has capacity for 1400 cattle.

Descriptive epidemiology of TB

Temporal TB trends

Unless otherwise specified, this report includes all new TB incidents detected during the reporting period. This includes Officially Tuberculosis Free Status Withdrawn (OTF-W) incidents and Officially Tuberculosis Free Status Suspended (OTF-S) incidents. OTF-W incidents are those in which at least one animal was identified with typical lesions of TB at post mortem (PM), and/or positive for *M. bovis* on culture from tissue samples. OTF-S incidents are those with one or more reactors to the Single Intradermal Comparative Cervical Tuberculin (SICCT) skin test, but without full confirmation of *M. bovis* infection by PM or bacterial culture.

In 2019 the number of new TB incidents increased by two in comparison with 2018, rising from 27 to 29 (Figure 2). However, incident numbers remained similar to previous reporting years, following the spike in 2015-2016 when the East Cumbria cluster commenced. The number of OTF-W incidents decreased from nine to five, whereas OTF-S cases rose from 18

to 24. This is in line with the trend observed over the last three years. In general, cases appear at any time throughout the year without any specific temporal pattern.

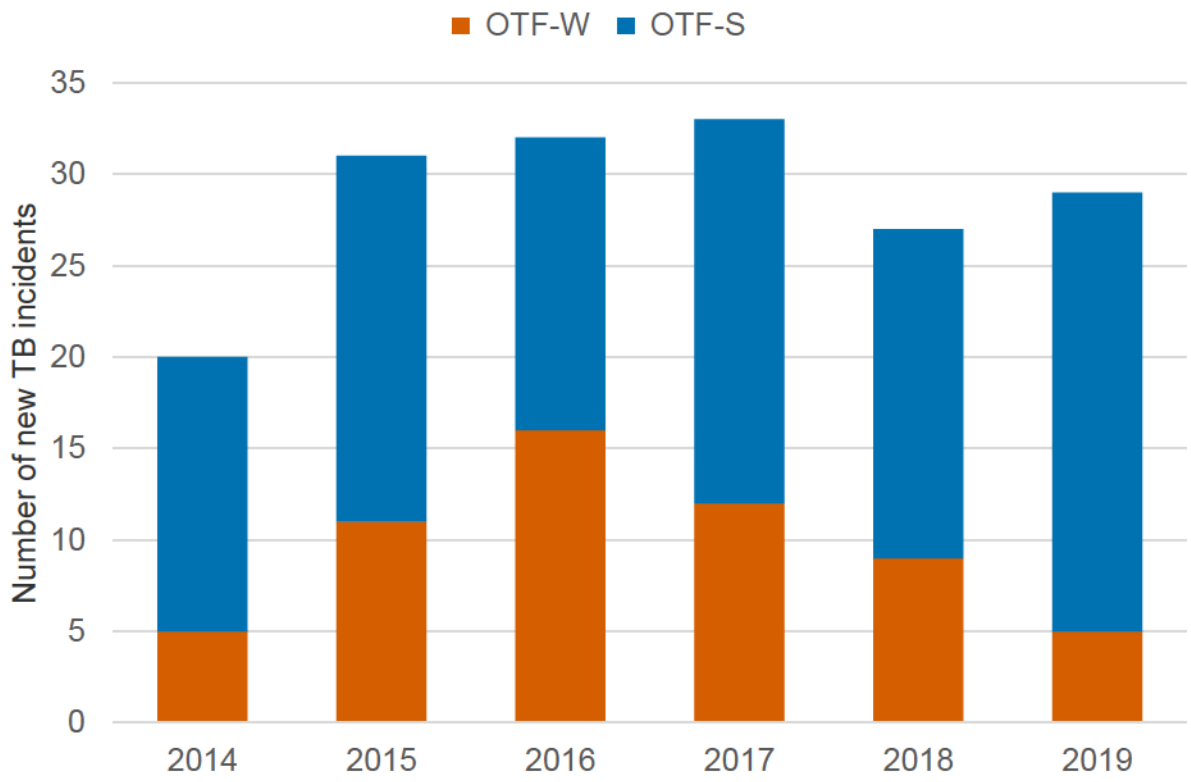


Figure 2: Annual number of new TB incidents in Cumbria, 2014 to 2019.

Geographical distribution of TB incidents

TB cases in Cumbria are situated predominantly around the boundary of the Lake District National Park, where the land is more suitable for farming: the majority of them to the East along the Eden Valley and to the south of the Lake District. As demonstrated in Figure 3, the main difference from the previous year is the geographical distribution of the incidents: the number of incidents in the south of the county doubled in 2019 (14) compared to 2018 (seven). This part of the county now has a potential hotspot area known as South Cumbria hotspot (HS26) where wildlife surveillance is taking place. There were six OTF-S incidents in the East Cumbria hotspot (HS21) during this reporting period and no new OTF-W incidents. One OTF-W incident in HS21, which started in 2018, concluded in 2019, while there were seven in 2017 and three in 2018.

As can be seen in Figure 4, a small number of potential radial zones within HS21 were not instigated during 2018 and 2017. This was due to the increased TB testing frequency that all cattle herds were already subject to in the area, which made radial testing unnecessary. In addition, some tests were instructed when the 3km radial zone extended beyond the hotspot boundary.

Before 2017, there were very few OTF-W incidents that did not trigger radial testing zones. These only occurred after field delivery teams had carried out a veterinary risk assessment and concluded that the risk of the disease spreading from the affected herd was negligible. The recommendation to not initiate radial testing around specific OTF-W incident herds were subsequently considered by TB leads and Veterinary Heads of Field Delivery, and only endorsed in a few cases. Radial testing plays an important role in the early detection of disease and prevention of wildlife infection, and also provides very valuable information in terms of how disease may have spread around confirmed incidents.

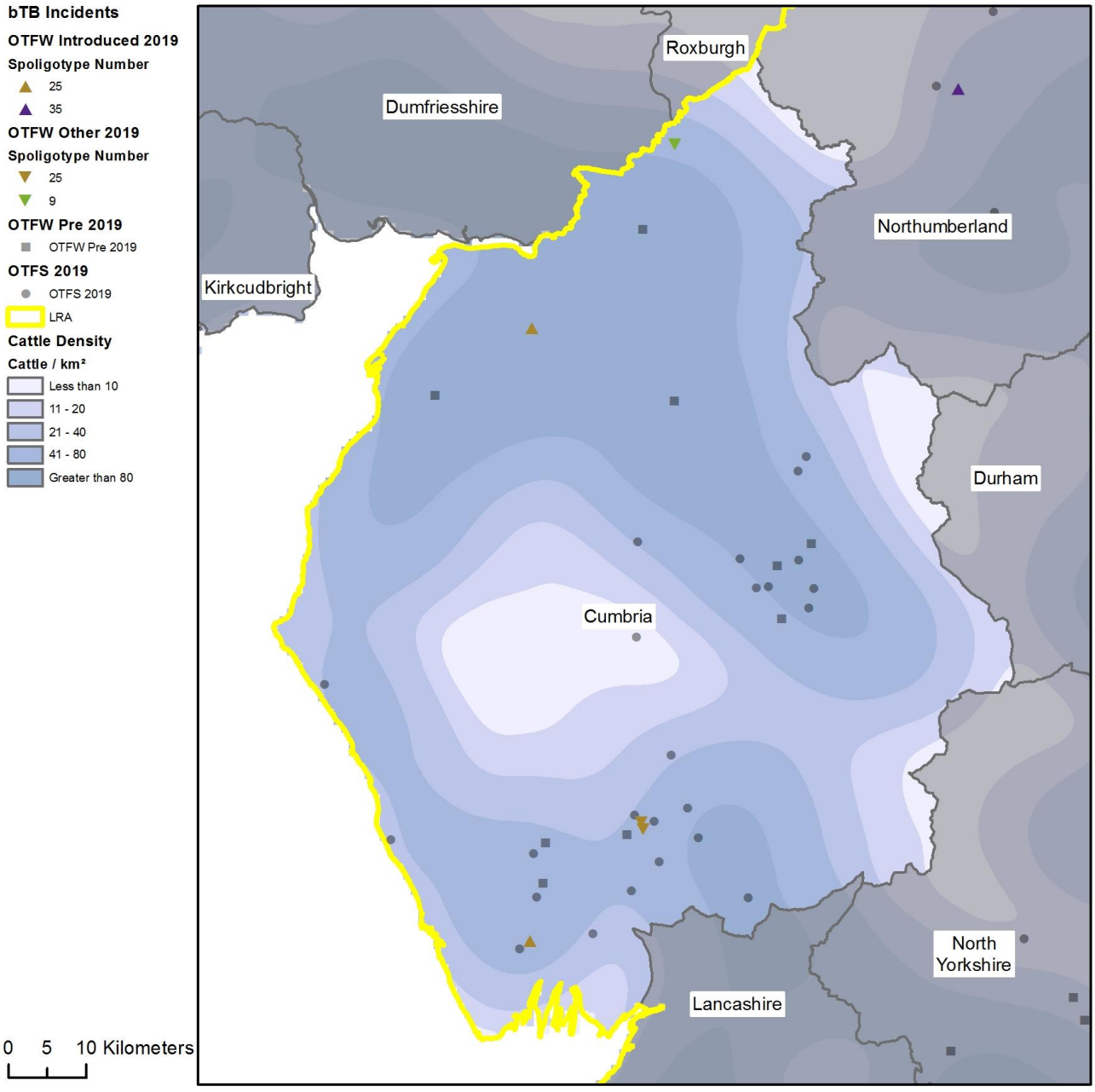
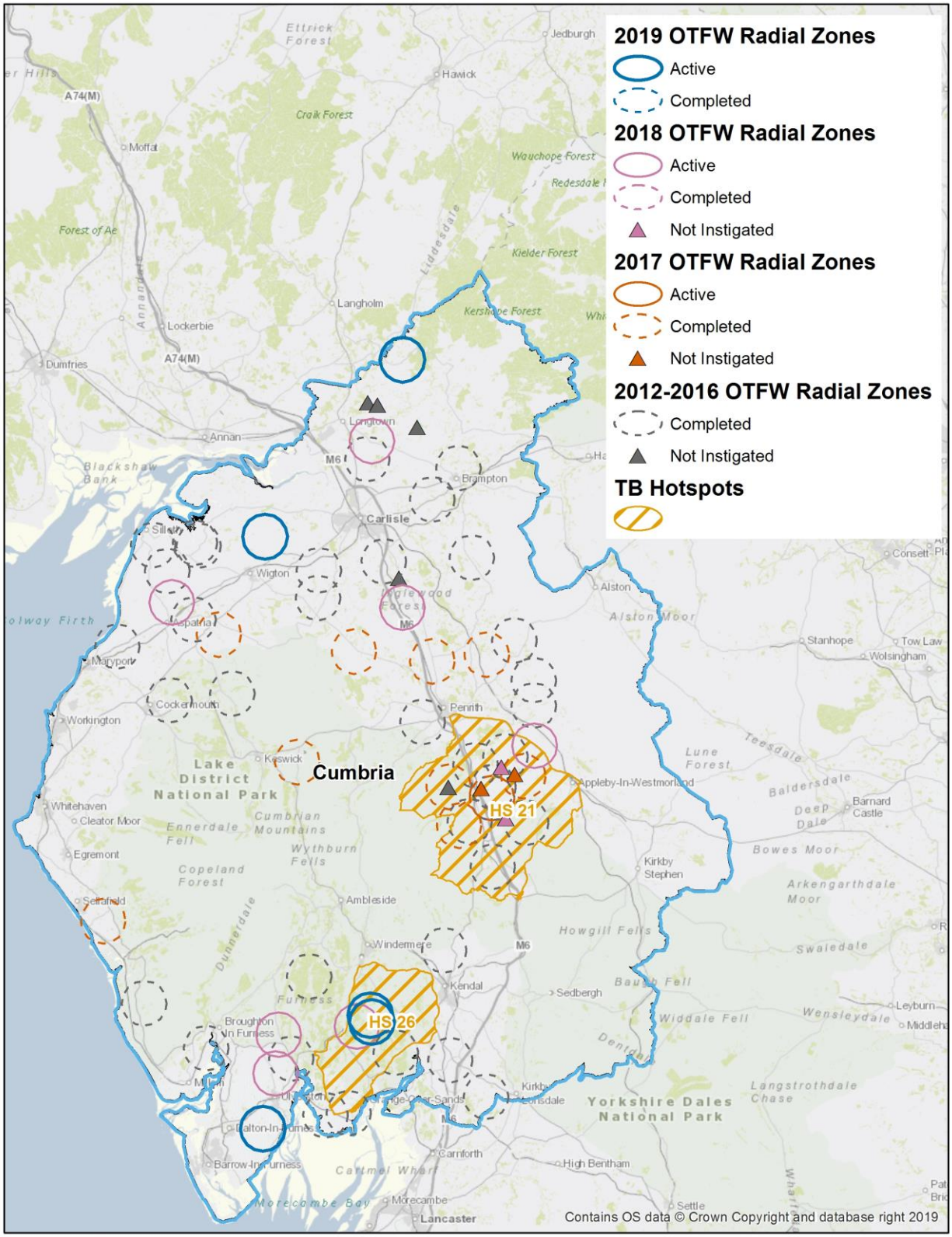


Figure 3: Location of cattle holdings in Cumbria with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the end of 2019, overlaid on a cattle density map.



Creator: GIS Team
Source: Sam
OTFW data as at 17th of April 2020
Ref: 20200428

Date: 28/04/2020

0 5.5 11 16.5 22 27.5 Kilometers

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Figure 4: Potential and confirmed hotspot areas and OTF-W radial surveillance zones that were active, completed or not instigated in Cumbria during 2019, by year of initiation.

HS21 – East Cumbria

The East Cumbria hotspot was established in 2016 and following the detection of three *M. bovis* positive badgers found dead in the area in 2017, enhanced TB control measures for both cattle and wildlife were put in place. There have been no further OTF-W incidents reported in 2019 and one ongoing from 2018 is now closed. However, there were six new OTF-S incidents in the reporting year. At the end of 2019 there were no herds under restrictions due to a TB incident in HS21.

Cattle herds are still subject to six monthly surveillance testing, and hence compulsory pre-movement testing. The degree of farmer compliance has been excellent throughout the area. The sixth round of testing is almost completed and the seventh is already underway at the time of writing this report.

One of the enhanced TB control measures in place for cattle herds in HS21 is to apply whole herd movement restrictions when only inconclusive reactors (IRs) have been disclosed. Two herds were affected by this policy in 2019: one of them became an incident and the other returned to OTF status at the retest.

A Local TB Steering Group was created during this period, with representatives from the local community including the National Farmers' Union (NFU), private veterinary surgeons (PVS), farmers, APHA and Defra. This group holds regular meetings with the aim of finding ways forward to eradicate TB from the area, discussing biosecurity, risk based trading and wildlife measures. Training for local PVSs and a TB awareness and biosecurity event for farmers, including farm walks, took place in January 2020.

HS26 – South Cumbria

In 2019 a cluster of cases emerged in South Cumbria near Cartmel Fell, between Kendal and Windermere. Following consultation with Defra TB Programme, the local APHA field delivery team set up a potential hotspot area, currently known as HS26 - South Cumbria. Wildlife surveillance in HS26 has taken place since August 2019, however *M. bovis* has not been identified in dead badgers or wild deer to date. Three cattle TB incidents in this area with the same genotype of *M. bovis*, also have identical Whole Genome Sequences (WGS). A fourth incident in the vicinity has a very closely related WGS to these three. This provides evidence of lateral spread of TB within the area, either by contact with infected cattle or wildlife. Wildlife surveillance is essential to determine whether infection is present in the local badger and/or wild deer populations and enlighten local epidemiological investigations. To date only four badger and three deer carcases have been submitted to APHA for bacteriological culture, with no positive results obtained for *M. bovis*. In addition to this, there is increased cattle surveillance in the radial zones triggered around the OTF-W incidents.

Other characteristics of TB incidents

Most of the TB incidents that concluded in 2019 in Cumbria affected beef herds (58%), and 23% of the remaining incidents were in mixed herds comprising both beef and dairy animals. Only a third of the cases had started in 2018. This can be partly attributed to radial testing

surveillance zones and the six monthly testing in HS21; because of this, TB testing in Cumbria is widespread throughout the year and thus TB cases can be disclosed at any time.

Duration of incidents

The duration of most TB incidents (considering both OTF-W and OTF-S incidents) is between 151 and 240 days. This accounts for two mandatory Short Interval Tests (SITs) and the time elapsing for reactor removal. It is worth noting that OTF-S incidents in HS21 are subjected to two SITs (and discretionary IFN-γ testing when required) as part of the enhanced control measures, which has an impact on the length of the restrictions. All HS21 OTF-S cases completed in 2019 lasted between 151-240 days except one, which continued for over 241 days.

Figure 5 shows the distribution of incident durations for cases that concluded during 2019. Two other cases lasted between 241-550 days: one was an OTF-W incident in a large dairy herd in which TB testing was split into several parts and also two rounds of IFN-γ testing were carried out, so prolonging the period of restriction. The other was an OTF-S case in South Cumbria in which the disclosure of an inconclusive reactor (IR) at the potential clearing SIT resulted in an extra 60 days lockdown until the IR retest, which was clear. In addition to that, a persistent (>550 day) incident that was ongoing throughout 2019 concluded in 2020.

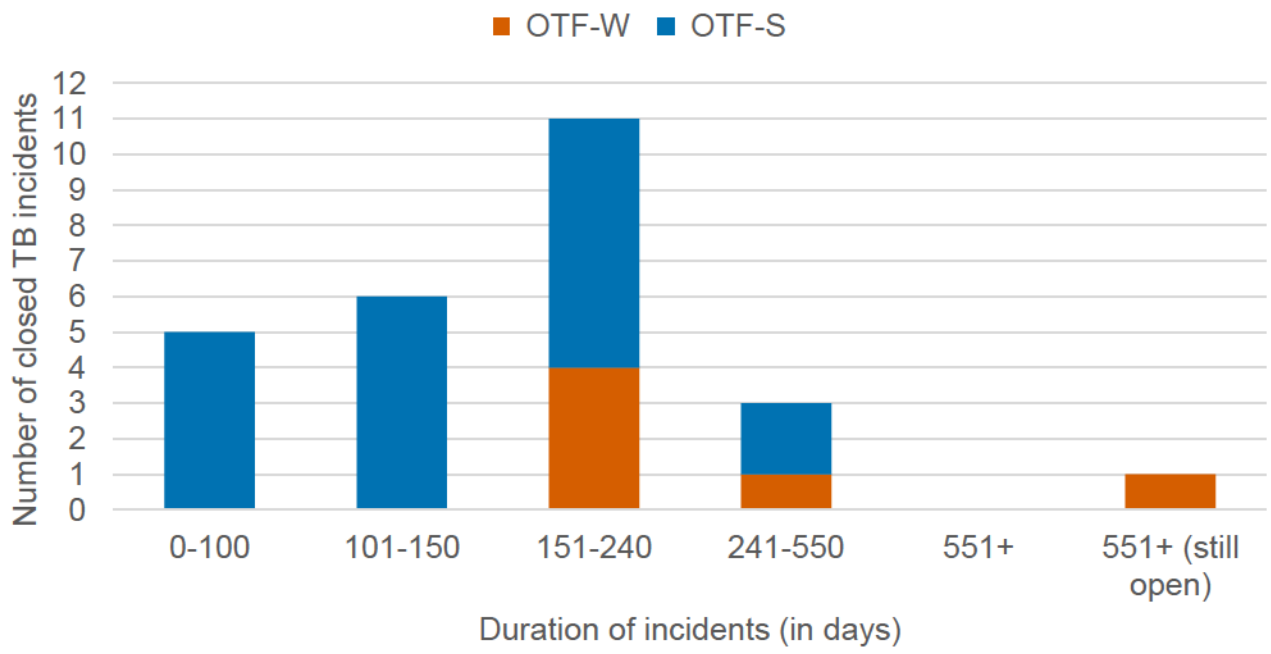

Figure 5: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Cumbria. Note that Licensed Finishing Units (LFUs) have been excluded.

Unusual incidents

During the reporting period, two incidents occurred in which an unusually large number of reactors were slaughtered, and one of these was also a persistent incident herd.

A medium size beef and dairy herd (250-300 head) in the south-west of the Lake District National Park and with land in potential hotspot HS26 (see Geographical Distribution of TB Incidents) suffered an incident which lasted nearly two years. Movements into this herd were limited and usually from the LRA, apart from two animals moved on from Cheshire in recent years. A total of 71 animals from this herd were slaughtered without a positive culture being obtained, even though a small proportion of them had visible lesions at post-mortem (five).The origin of infection in this herd remains uncertain.

The second incident was in a large dairy herd with over 2000 cattle located in eastern Cumbria. Two IFN-γ herd tests disclosed 86 and 62 positive animals, all of them had no visible lesions. Restrictions were lifted in December 2019, after fifteen months of movement restrictions. A radial zone was triggered by this incident for surveillance but no further cases have been disclosed. Cattle on this farm are mostly purchased through local markets, always from four yearly tested areas (mostly from Cumbria, but also from Scotland, the LRA and other European countries). Of the 158 TB reactors slaughtered during this incident, only 16 were not homebred and seven of these had been imported from Sweden during the incident. The *M. bovis* isolated from two skin test reactors with visible lesions of TB detected at the beginning of this incident was assessed against other 25:a incident isolates that appeared in the Southwest of the county, but their WGS appears to be unrelated. However, it was linked to an OTF-W incident in 2015, which is in the local area, indicating that local spread may have occurred via cattle to cattle contact or local wildlife. Note that this farm is subject to the enhanced TB testing regime as some of the land is included within the perimeter of HS21. However, it is believed that this case is not epidemiologically linked to the hotspot.

Genotypes of *M. bovis* isolated

As presented in Figure 6, the genotypes isolated in the county in 2019 are 25:a and 9:d. For the first time since 2015, the endemic strain in HS21 (17:z) has not been cultured in any cattle herds (although six herds in HS21 were under restrictions during 2019).

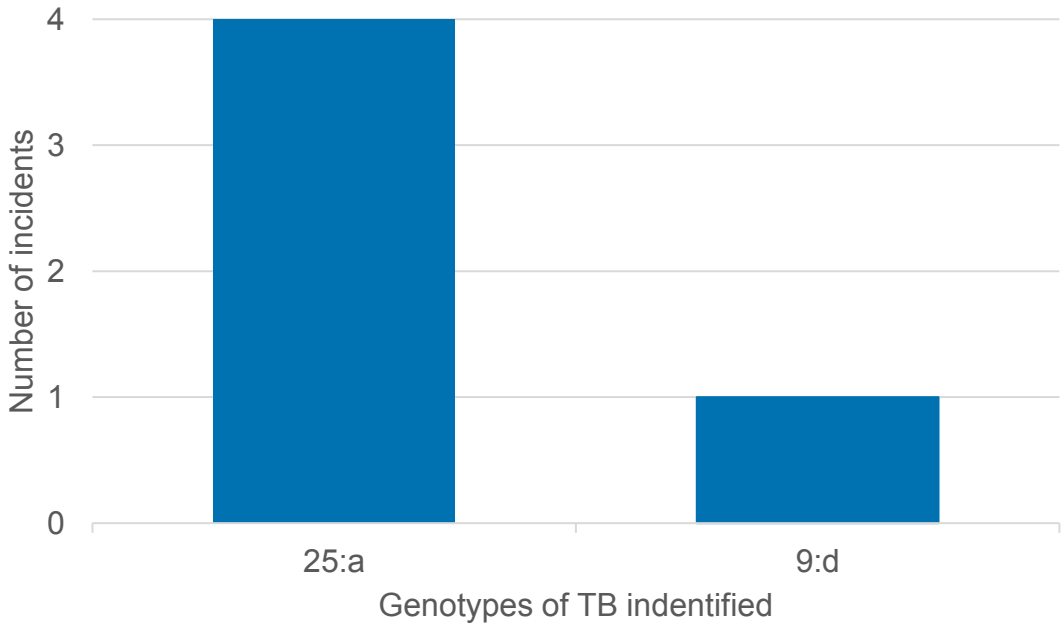

Figure 6: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Cumbria in 2019.

An incident near the Scottish borders disclosed the 9:d genotype, even though no risk pathway for the transmission of disease into this holding has yet been established. This genotype has been found in other incidents in North Cumbria and Scotland, but looking at the WGS they are relatively distant. The closest related WGS is a Scottish incident, indicating a possible purchased origin.

The 25:a genotype of *M. bovis* was identified in four incidents. Two of these incidents were part of the South Cumbria cluster around Cartmel Fell, where HS26 was established in 2019; the third one was just a few miles away from this cluster, and the fourth one is in the north of the county. WGS analysis of these isolates has shown that the cases in the HS26 cluster have identical sequences. Further research revealed that the animal from the third incident (from which the isolate was obtained) had actually resided for two years in a holding within HS26, suggesting that it had most likely become infected while there. This provides some evidence that an undetected reservoir of *M. bovis* in local wildlife could be a source of infection for some of the cattle herds with TB incidents in this cluster. Although wildlife surveillance is being carried out in this area, the number of submissions has been very low and *M. bovis* has not been isolated in wildlife to date. With regards to the northern incident, it is believed that the source of infection could have been purchased cattle from the HRA or Edge Area, but there is no WGS analysis available at this stage to elaborate further on any potential links with the southern cluster of this genotype.

Suspected sources, risk pathways and key drivers for TB infection

The key drivers of the TB incidents detected within the reporting area were as follows:

- Purchase/movement of undetected infected cattle within LRA and from the Edge Area and HRA
- Infected wildlife reservoirs (badgers in HS21 and possibly HS26)
- Undetermined sources

It can be challenging to retrospectively establish the route of infection for a TB incident herd. The Animal and Plant Health Agency (APHA) aims to complete an epidemiological assessment for all TB incidents in the LRA (both OTF-W and OTF-S). This includes a thorough on-farm investigation and scrutiny of routinely collected data; such as cattle movement records, and the results of molecular analyses where available.

During the assessment up to three risk pathways of infection are selected for each herd. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd. The score assigned has been updated this year to reflect developing understanding of how likelihood is being assessed in practice. It is recorded as either definite (score 8), most likely (score 6), likely (score 4) or possible (score 1). The source(s) for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely or possible can contribute towards the overall picture for possible routes of introduction in to a herd. If the overall score for a herd is less than six, then the score is made up to six using the 'Other/Unknown Source' option. Buffering up to six in this way helps to reflect the uncertainty in assessments where only 'likely' or 'possible' sources are identified.

The weight of infection outputs in Appendix 4 are produced by combining the data from multiple herds and providing the proportion of pathways in which each source was identified, weighted by certainty that each source caused the introduction of TB. The outputs do not show the proportion of herds where each pathway was identified (this is skewed by the certainty calculation). Genotyping of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however genotypes are not determined for OTF-S herds. The inclusion of OTF-S herds in these calculations increase the uncertainty in the outputs. As a result, the relative proportions of each risk pathway is very approximate and only broad generalisations should be made from these data. A more detailed description of this methodology is provided in the Explanatory Supplement to the 2019 bovine TB epidemiology report for England (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

Movements of cattle were the source of infection attributed to three of 29 incidents in 2019 (two OTF-W and one OTF-S). It must be noted that it is not always movements from the HRA and Edge Area that cause TB incidents in Cumbria: two of these were attributed to animals purchased from local farms. Also contact with local cattle is considered to be a potentially important risk pathway in the South Cumbria cluster, where most of the incidents were disclosed by radial testing.

In just over 30% (9) of the incidents in Cumbria, wildlife was mentioned as a potential risk pathway, with a high level of certainty in eight cases. Six of these incidents were located within HS21 or HS26. There is no confirmation of *M. bovis* infection of wildlife in HS26 to date, although field epidemiological investigations point to a likely involvement. Please see Appendix 4 for further information on suspected sources of *M. bovis* infection in the county.

In instances where not enough evidence is available (as happens with many OTF-S cases where no genotype is obtained) and there are no clear risk pathways, it is difficult to ascertain the source of infection. These cases have been recorded as 'undetermined'. This also applies when although several sources of infection have been considered, none of them has a high level of certainty as shown in Figure 7a. In order to reduce the uncertainty, it will be necessary to gather new evidence of the disease situation in local wildlife populations. The use of WGS techniques when *M. bovis* is confirmed, either in cattle or wildlife, is very valuable in achieving this, although it depends on wildlife being submitted for surveillance.

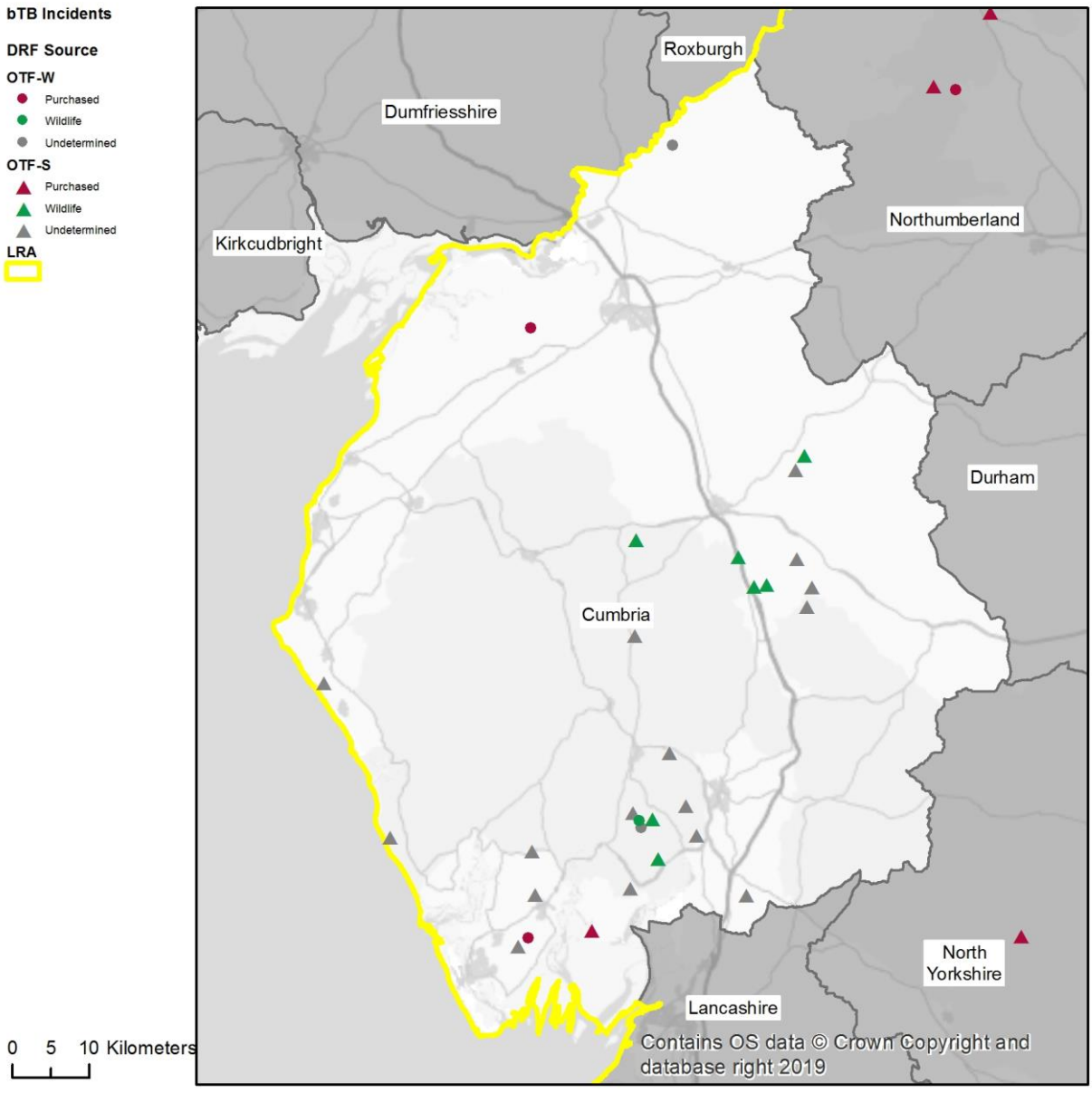

Figure 7a: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Cumbria, which started in 2019.

As previously mentioned, the main difference in 2019 is the increased number of cases that have emerged in the south of the county, whereas the east of Cumbria saw no OTF-W cases. This is depicted in Figure 7b, which shows the location of the main genotypes found in the endemic areas in Cumbria, located respectively in each of the hotspots.

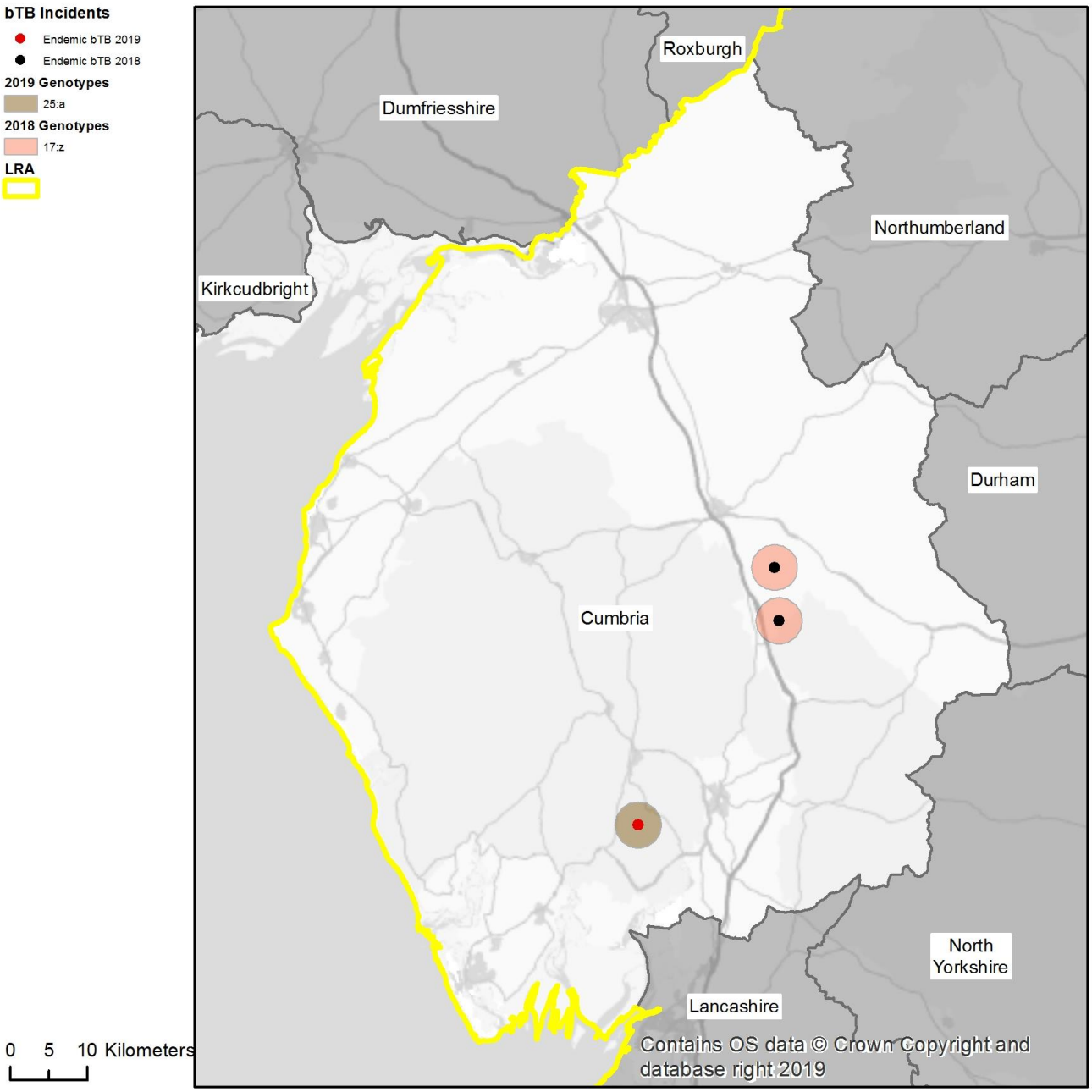

Figure 7b: Genotypes of *M. bovis* detected in Cumbria in 2018 and 2019, where a wildlife source was attributed with a 50% certainty or above, as an indication of endemic infection within the local wildlife populations (OTF-W incidents only).

TB in other species

Badgers and other wildlife

Farmers report thriving populations of badgers in certain areas of Cumbria. Their activity has been surveyed in parts of the Eden Valley (HS21) for TB control purposes where cattle incidents have been associated to badgers infected with a common genotype of *M. bovis*. This hotspot underwent a second year of licensed badger culling in 2019. There is also a rising population of badgers reported in the south of the county and some have been seen near farmsteads. Badgers are deemed to be one of the possible sources of infection for some OTF-W incidents in the south of the county although *M. bovis* has not been confirmed in wildlife in this area to date. WGS analysis of the local incidents suggests infected wildlife may be playing an important role in disease transmission here.

Wild deer (mostly red and roe deer) are often observed by Cumbrian farmers in different parts of the county, wandering through grazing lands and into nearby woodlands. Surveillance is carried out on shot deer and any carcases with suspect lesions of TB reported to APHA as required by law. The Cumbrian Deer Initiative has run sessions of TB awareness in some of their events in recent years, on the back of the East Cumbria TB hotspot. No cattle TB incidents in the county have been attributed to deer and there were no confirmed isolates of *M. bovis* in wild cervids in 2019.

Other domestic species

During 2019 there were no laboratory confirmed incidents of *M. bovis* in Cumbria in any domestic non-bovine farm animals (camelids, goats, sheep or pigs), pets, zoo animals, captive (farmed/park) deer or captive wild boar.

Detection of incidents

In Cumbria, the vast majority (21 out of 29) of new incidents in 2019 were identified through other types of TB testing such as radial tests (RAD), pre-movement testing (PRMT), specific hotspot testing (CT-HS1) and post-incident six-month tests (6M), rather than routine surveillance tests. This highlights the efficacy of the additional control measures that have been applied specifically to address areas in which infection may have potentially occurred (either residual or via spread, recently introduced or re-introduced infection). The eight remaining incidents in 2019 were detected by routine herd testing (RHT), whole herd testing (WHT), new herd testing (CT-NH) and one of them through passive surveillance (routine post-mortem meat inspection) in a slaughterhouse (SLH), as shown in Figure 8.

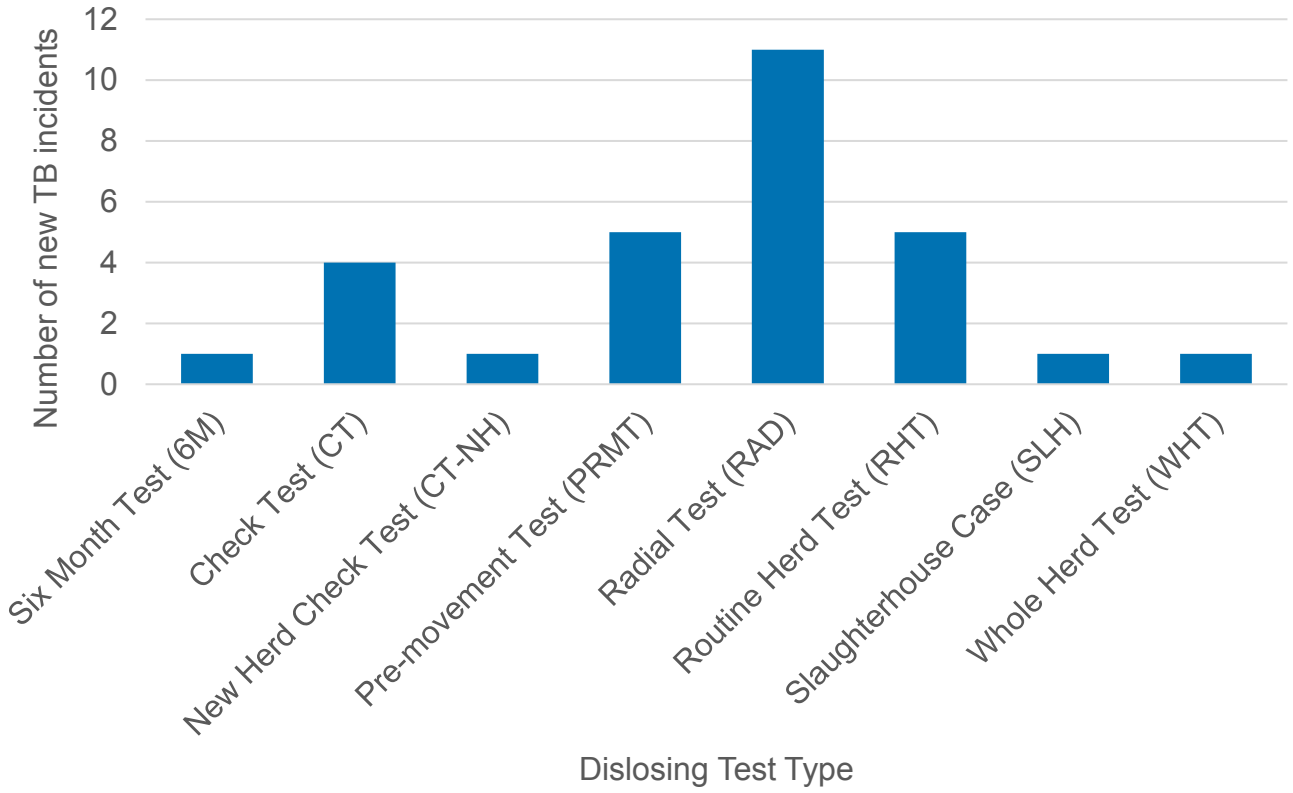

Figure 8: Number of TB incidents (OTF-W and OTF-S) in Cumbria in 2019, disclosed by different surveillance methods.

The fact that only one incident out of 29 was detected by routine post-mortem surveillance in a slaughterhouse demonstrates that active surveillance (both routine and enhanced on-farm testing) constitutes a highly valuable tool in the early detection of disease, which results in a potential decrease of TB spread between herds.

Two of the incidents had suffered previous TB incidents although it is believed that in both cases, disease was re-introduced via infected wildlife rather than being residual infection in cattle from the previous incident.

In order to ensure timely detection of disease and that all truly infected animals are revealed, it is of paramount importance that diagnostic tests are performed to the highest standard. The tuberculin skin test used on its own could miss a small proportion of truly infected animals, known as false negatives. However, when it is applied in combination with the IFN-γ parallel test, the rate of false negatives decreases dramatically.

Skin test reactors and interferon gamma test positive animals removed

As presented in Figure 9, there was a rise in the number of animals slaughtered for TB control purposes from 2014 to 2018, followed by a marked decline in 2019. However, the number of incidents has been relatively similar (Figure 2 and Appendix 3). In 2019, 190 cattle were slaughtered in Cumbria due to TB, nearly 100 less than in 2018. This comprises 77 skin reactors and 113 IFN-γ reactors. Also since 2016, positive IFN-γ test animals have been a substantially higher proportion of the total TB slaughters than skin test reactors. One of the reasons for this might be the use of discretionary IFN-γ testing in OTF-S herds in HS21 as part of the enhanced cattle measures for the area. There have also been some herds in which more than one round of IFN-γ has been applied.

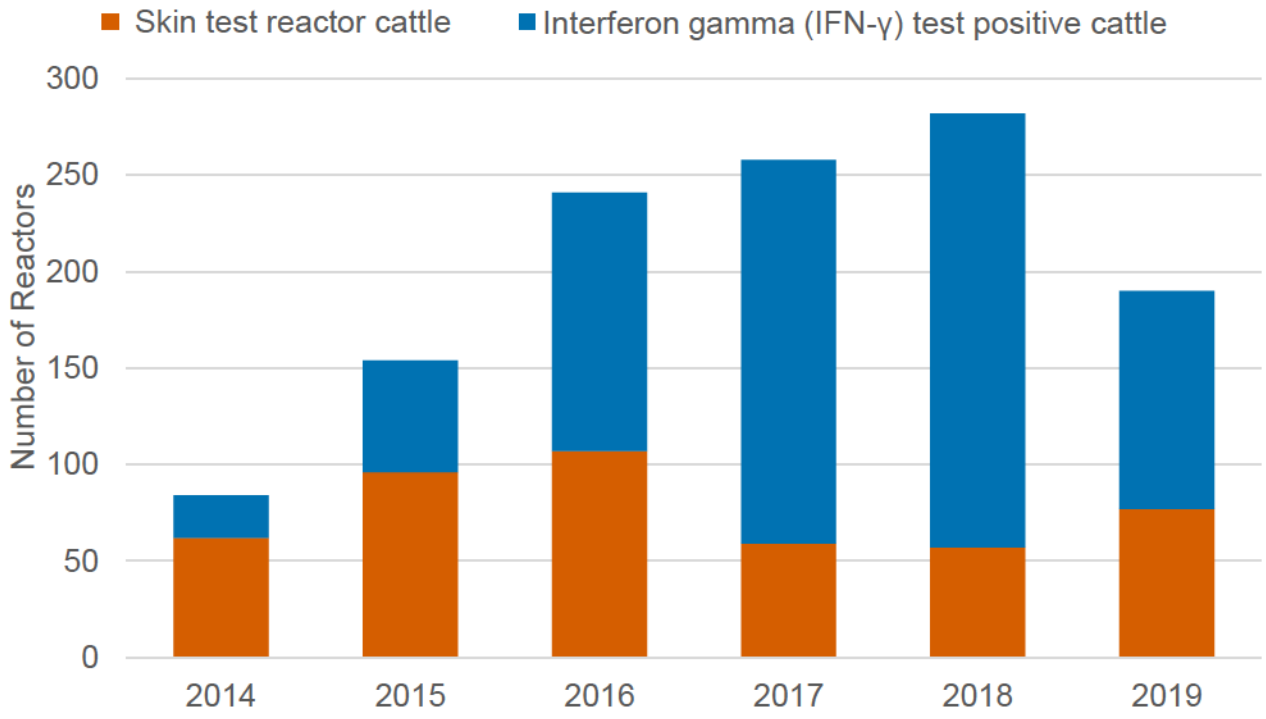

Figure 9: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Cumbria, 2014 to 2019.

One of the main impacts of TB incidents is on the ability to move stock off the restricted premises, which can have consequences on the numbers of breeding animals, weaned beef calves, store cattle, etc. The same applies to sourcing stock to replace the TB reactors removed, or other replacements. This proves even more difficult for pedigree animals. Introduction of replacement cattle is not permitted until after the first incident herd test and it has to be carried out under a licence from APHA, which is only granted after a thorough veterinary risk assessment to ensure that mitigation measures are followed and the disease is not spread. Another consideration is that if cattle purchased during an incident become

reactors at subsequent tests, there is a 50% reduction in the compensation paid to the farmer.

Restrictions also make herds more difficult to manage when they operate out of premises in different locations (i.e. heifers being reared away where there might be no facilities for calving or milking). Beef store businesses might run out of space if they have to finish their animals and this can compromise the welfare of the stock. Also there is a significant economic impact in these cases as they rely on a constant turnover of animals for cash flow. Approved finishing units for TB restricted cattle (AFUs) are a way for these businesses to release some stock, although prices are not as competitive.

In every incident, farmers are urged to consider contingency plans in case the restrictions last for a longer period of time, with the aim of mitigating potential issues promptly without compromising animal welfare.

Summary of risks to Cumbria

Cumbria is the most northern county in the West of England and it is adjacent only to other LRA counties and Scotland. These English counties are, in clockwise order, Northumberland, County Durham, North Yorkshire and Lancashire. The Western perimeter is the Irish Sea coastline.

The main risk that other areas pose to Cumbrian livestock is in the form of cattle movements. In 2019 over 86,000 cattle moved into Cumbrian herds, of which only 2% had originated directly from the HRA or the Edge Area of England. Most of the movements from LRA counties are mainly within Cumbria, although this data refers to the last resident holding of the animals before the movement, and not the place of birth or other holdings in which they might have lived.

Just over 40% of the cattle moved into the county do so via livestock auctions. There are nine auctions in Cumbria, which are widely used. Some of these markets in the north of Cumbria facilitate trade with Scotland too. Farmers are increasingly aware of the risks of purchasing cattle from high risk herds and their trading practices are starting to become more informed. APHA is working with local stakeholders to promote risk based trading practices in the area, as part of the ongoing work in HS21.

The spread of TB from cattle moved into the county from other areas is mitigated by the pre- and post-movement testing policies introduced in 2006. However, these are only required when cattle move out of herds tested annually or more frequently, which in the LRA means herds included in radial zones or subject to post incident testing. Similarly, Scottish herd owners must adhere to the Scottish rules for pre-movement testing when moving cattle out of Scotland. Hence not all cattle that move to Cumbria from neighbouring regions will have been subjected to pre-movement testing and there are instances in which cattle may be moved without ever having been tested.

APHA carry out tracing tests on cattle moved into Cumbria from herds that are found to be infected with TB after the cattle movement took place. Since 1st April 2017, these skin tests are read at severe interpretation.

There are no known areas of endemic TB in wildlife or other clusters of TB incidents in the neighbouring counties that could pose a real risk to Cumbria. The density of cattle in the border between Cumbria and the eastern counties of Northumberland, Durham and North Yorkshire is relatively low due to the Pennine Chain, which separates the North West of England from Yorkshire and the North East of England. Lancashire to the south has a low level of disease. Therefore, the overall risk of transmitting TB from these counties to Cumbria is assessed as low.

Summary of risks from Cumbria to the surrounding areas

The Cumbrian areas of higher incidence of disease are in the east and the south of the county, where the two active TB hotspots (HS21 and HS26) are located. The cluster in the east Cumbria does not pose a risk geographically as the Pennine Chain acts as a physical barrier. There are some incidents in the south near the aforementioned HS26 and relatively close to the border with Lancashire that could perhaps pose a risk, although through cattle movements rather than wildlife or local spread. This could be facilitated by livestock auctions such as those at Kendal or Lancaster.

The enhanced cattle surveillance going on in parts of Cumbria (like in HS21 and radial zones), mitigates the risk of disease spreading to other counties, as premises in such areas are also required to pre-movement test their stock unless moved directly to slaughter or finishing units.

Nevertheless, the incidence of TB in Cumbria is still low, and therefore the risk to surrounding areas is deemed low as well.

Assessment of effectiveness of controls and forward look

The incidence of TB in Cumbria has been relatively similar over the past few years with just a slight undulation in the annual number of TB incidents. Nevertheless a slow decrease in OTF-W cases and number of animals slaughtered for TB control purposes could be perceived in 2019.

The majority of incidents have been disclosed using enhanced surveillance such as radial and hotspot testing. This is a very positive outcome, since these incidents were detected at

an earlier stage, avoiding further spread of disease within the herd, local farms and wildlife. It also demonstrates that enhanced cattle surveillance is a key factor in the control of TB in the LRA, and will continue to be in the forthcoming years.

The situation in HS21 (East Cumbria) is improving: the second round of badger culling was completed in November 2019. The incidence of disease in local cattle herds seems to be decreasing steadily, however control measures must not be relaxed in order to avoid reoccurrence. Discussions are being held at present to assess what actions will be required in 2020 with regards to TB controls in the badger population. Badger vaccination may be an important component of the exit strategy from culling in HS21, in order to protect younger generations of badgers and stop the spread of disease amongst them.

The lack of wildlife surveillance obtained to date in South Cumbria makes it rather difficult to form an opinion of what the likely progression of TB will be in this area. Considering the spread of disease observed between local cattle herds, it is essential to gather as much evidence as possible from the local wildlife to ascertain their level of infection, if any, and the degree of their involvement. This will also allow APHA to put the relevant control measures in place in a timely fashion.

In order to overcome TB in this part of the LRA it is paramount to involve biosecurity and informed cattle trading. Awareness of both has been growing in the county since the development of HS21, which has acted as a warning for other communities, although there is still much work to do in this respect. Many farmers are still reluctant to implement improved biosecurity as it sometimes involves an extra expense, however these measures need not be prohibitively expensive to be effective. Responsible sourcing of cattle replacements seems to be well received, but it takes time to do proper research using the available information, which some farmers don’t have.

Current measures are to continue and should aid in the prompt detection of cases. This together with safer trading practices and a better understanding of herd biosecurity will, in a few years’ time, hopefully contribute to the slowing down of the spread of disease and eventually reverse it.

Appendices

Appendix 1: overview of risk and surveillance areas of England and Low Risk Area objectives and controls

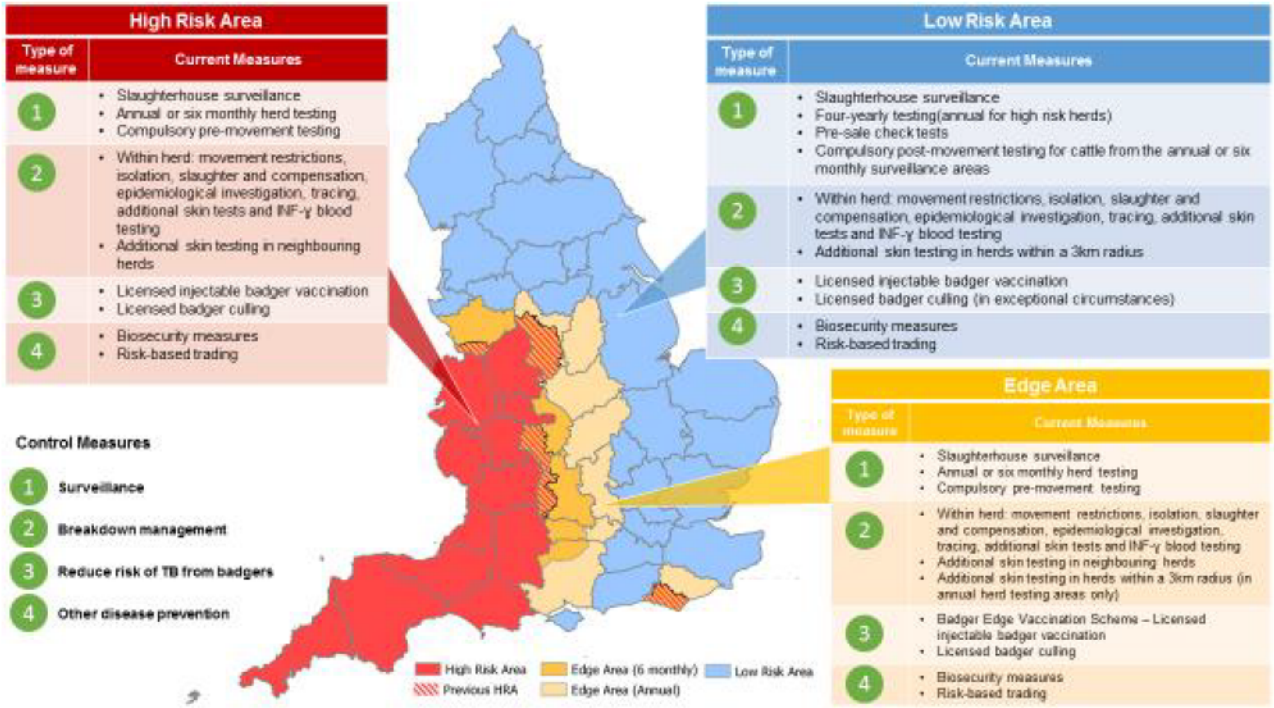

Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Tuberculosis-Free Status for England. Map based on information published on www.tbhub.co.uk.

Policy objectives for the Low Risk Area

Progressive attainment of OTF status for individual counties (or groups of counties) within the current LRA, with the declaration of OTF status for all LRA counties by 2025. For more information about the government's strategy for achieving Officially Bovine Tuberculosis Free status for England, published in 2014 and independently reviewed in 2018, see:

https://www.gov.uk/government/publications/a-strategy-for-achieving-officially-bovine-tuberculosis-free-status-for-england

https://www.gov.uk/government/news/government-sets-out-next-phase-of-strategy-to-combat-bovine-tuberculosis

Key control measures in the Low Risk Area

Surveillance:

- default four-yearly routine surveillance (skin) testing of cattle herds, with annual testing for a small proportion of high risk herds
- voluntary pre-sale skin check tests
- compulsory pre and post-movement testing for cattle entering farms in the LRA (to live) from the annual or six monthly surveillance areas of England and Wales
- additional targeted surveillance (radial testing) of cattle herds located within a 3km radius of new incident herds with OTF status withdrawn (OTF-W) following the detection of lesion-positive test reactors and/or culture-positive animals
- slaughterhouse (SLH) surveillance (through PM meat inspection) of all cattle slaughtered for human consumption

Management of incidents:

- herd movement restrictions, isolation and rapid slaughter of TB test reactors and any direct contacts with statutory compensation payments to farmers, epidemiological investigation, tracing tests (at severe interpretation), and short interval skin testing supplemented in all herds affected by OTF-W incidents with mandatory interferon gamma (IFN-γ) blood testing

TB controls in the wildlife reservoir (badgers):

- licensed injectable badger vaccination
- licensed badger culling in exceptional circumstances, where *M. bovis* infection has been confirmed in badgers and it has a clear epidemiologically link with a local cluster of TB in cattle (e.g. East Cumbria TB hotspot)

Other measures:

- biosecurity measures
- promotion of responsible sourcing of cattle (e.g. through the use of the ibTB online (www.ibtb.co.uk) mapping application)

Summary of enhanced TB control measures in Cumbria

In addition to all the standard LRA requirements, the enhanced disease control measures implemented for HS21 in East Cumbria have been maintained and will continue (with minor adjustments) in 2020. These include:

- Six monthly surveillance skin testing of all cattle herds, with consequential pre-movement testing of all cattle over 42 days old moving out of these herds (except to slaughter). By the end of 2019, many herds had completed their fifth round of six-monthly herd tests under this regime. Under each round, approximately 30,000 cattle have been tested in approximately 180 herds. The level of compliance with this testing regime has been outstanding from both farmers and PVSs.
- Whole-herd movement restrictions are applied to herds with inconclusive reactors only, pending the 60-day re-test of those animals.

- Mandatory IFN-γ blood testing of all the herds sustaining an OTF-W incident and discretionary blood testing of certain OTF-S incident herds.
- Severe interpretation of skin tests for both OTF-W and OTF-S incident herds.
- Samples from all cattle with visible lesions of TB at post mortem submitted for culture and genotyping.
- Ad hoc surveillance of camelid (skin testing followed by an antibody test) and goat (skin testing only) herds.

There have been five radial surveillance zones instigated in 2019 around the five OTF-W incidents mentioned in this report, plus seven zones that remain active from 2018 incidents.

One partial exemption to the mandatory deployment of the IFN-γ test was granted for an OTF-W incident in a beef fattening herd, where some of the stock were kept at separate locations and had no contact with the group in which the reactor was disclosed. In addition to that, many animals were due to be slaughtered shortly after the blood test, so they were still subjected to passive surveillance. A veterinary risk assessment was written by field staff and endorsed by the relevant Veterinary Advisor to this effect.

An incident in South Cumbria became persistent during the reporting period. As per procedures for such cases, APHA carried out additional investigations and action plans were monitored and reviewed in detail. APHA field staff held meetings with the farmer, their PVS, and local NFU to discuss the strategy and advise the farmer going forward. An application was presented by the case veterinarian to policy colleagues, to consider antibody testing of the herd with the aim of finding hidden infective animals. This was declined and non-specific reactor procedures then followed. At a later meeting with the farmer, PVS, NFU, and APHA representatives, private antibody testing of specific animals was discussed, but in the end not carried out. This incident has now concluded in February 2020.

In autumn 2019, a steering group of local stakeholders was formed with the purpose of selecting and promoting tools to improve herd resilience, initially within the East Cumbria hotspot (HS21). It is hoped that the interventions will provide a lasting legacy in the area. There was no limit to the tools used, as long as they focused on improving knowledge and uptake of biosecurity measures. Defra provided funding to put in place the chosen tool(s). The group discussed many initiatives that could be implemented, but decided that the following would be best suited to the area:

- Free on-farm advice delivered by private vets, this includes up-skilling of the private vets.
- Open farm event to launch bespoke advisory visits.
- All cattle keepers to receive an information pack, including a farm level data report, badger sett survey (if applicable) and a flyer for the advisory visits.

Appendix 2: cattle industry in Cumbria

Table A2.1: Number of cattle premises by size band in Cumbria at 1 January 2019. (RADAR data)

Size of Herds	Un*	1-50	51-100	101-200	201-350	351-500	501+	Total Number of Herds	Mean Herd Size	Median Herd Size
Number of Herds in Cumbria	20	1095	503	578	393	176	149	2914	148	83

*The number of herds with an undetermined size.

Table A2.2: Number of animals by breed purpose in Cumbria at 1 January 2019.

Breed Purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of Cattle in Cumbria	211,060 (49%)	203,927 (47%)	14,877 (3%)	41 (<0.01%)	429,905

Appendix 3: summary of headline cattle TB statistics

Table A3.1: Herd-level summary statistics for TB in cattle in 2019.

Herd-level statistics	2017	2018	2019
(a) Total number of cattle herds live on Sam at the end of the reporting period	3476	3398	3398
(b) Total number of cattle herds subject to annual TB testing (or more frequent) at the end of the reporting period (any reason)	825	911	698
(c) Total number of whole herd skin tests carried out at any time in the period	1655	1775	1716
(d) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	1302	1390	1386
(e) Total number of OTF cattle herds at the end of the report period (i.e. herds not under any type of TB2 restrictions)	3435	3351	3355
(f) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period.	3460	3388	3384
(g) Total number of new TB incidents detected in cattle herds during the report period	33	27	29
• OTF status suspended (OTF-S)	21	18	24
• OTF status withdrawn (OTF-W)	12	9	5
(h) Of the new OTF-W herd incidents, how many:			
• occurred in a holding affected by another OTF-W incident in the previous three years?	2	0	0
• could be considered secondary to a primary incident based on current evidence?	1	0	1

Herd-level statistics	2017	2018	2019
• were triggered by skin test reactors or 2xIRs at routine herd tests?	1	0	1
• were triggered by skin test reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, post-movement, etc.)?	2	2	3
• were first detected through routine slaughterhouse TB surveillance?	2	2	1
(i) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	14	9	8
• OTF-W	3	0	3
(j) Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W incidents that began in a previous reporting period)	8	6	6
(k) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	1 cat 1 llama	0	0

Table A3.2: Animal-level summary statistics for TB in cattle in 2019.

Animal-level statistics (cattle)	2017	2018	2019
(a) Total number of cattle tested in the period (animal tests, blood and skin)	296,708	320,880	285,776
(b) Reactors detected in tests during the year:			
• tuberculin skin test	59	57	77
• additional IFN-γ blood test reactors (skin-test negative or IR animals)	199	225	113
(c) Reactors detected during year per incidents disclosed during year *	7.82	10.44	6.55
(d) Reactors per 1000 animal tests	0.87	0.88	0.66
(e) Additional animals identified for slaughter for TB control reasons (DCs, including any first-time IRs)			
• DCs, including any first-time IRs	9	9	10
• Private slaughters	2	0	3
(f) SLH cases (tuberculous carcases) reported by the FSA during routine meat inspection.	15	10	7
(g) SLH cases confirmed by culture of *M. bovis***	2	1	1

* Note: reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count here

** Note: not all cases reported are submitted for culture analysis. All cases reported are from any period prior to or during restrictions

Appendix 4: suspected sources of *M. bovis* infection for all of the new OTF-W and OTF-S incidents identified in the report period

Table A4.1: Suspected sources of *M. bovis* infection for all of the new OTF-W and OTF-S incidents identified in Cumbria, in 2019.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	6	3	6		29.0%
Cattle Movements	4	3	1		11.9%
Contiguous	7	2			8.1%
Residual Infection					0.0%
Domestic Animals					0.0%
Non-specific Reactor	4	4			11.6%
Fomites	1				0.7%
Other Wildlife	3	1			3.8%
Other or Unknown Source	5	4	1		35.0%

Please note that each TB incident could have up to three potential pathways so totals may not equate to the number of actual incidents that have occurred. Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement for England 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

Appendix 5: assessment of the origin of (and potential for spread of infection from) all of the new OTF-W incidents identified in the report period

A risk matrix was used to identify isolated incidents that were likely to have been introduced to the LRA by cattle movements, while not causing any onward local spread. The following two questions were considered for each incident, and a score attributed. TB incidents with a score of 1A, 1B or 2A may be removed from the county TB incidence calculations during an application for OTF status (but remain in the incidence calculations in this report).

What is the probability of *M. bovis* infection being introduced to the LRA via infected cattle movements?

1. Definite - for example, traced reactors found in the LRA OTF-W incident herd in question as a result of spread tracings from another TB incident herd, genotype/WGS linked.

2. Likely - for example, a Reactor or IR originated from a previous incident herd (and the genotype does not suggest otherwise), other cattle were moved into the herd from previous incident herd (but were subsequently slaughtered without testing), or the trading practice of herd provides likely evidence (purchasing large numbers of cattle from High Risk Area (HRA), or Edge Area, High and Intermediate TB areas of Wales, or from the island of Ireland).

3. Possible - not a closed herd, but cattle are purchased from the LRA, Scotland and/or EU Member States.

4. Not likely - indigenous infection is known in the locality, closed herd, genotype/WGS has been identified in local wildlife.

What is the probability of this being an isolated, sporadic ('one-off') incident, without secondary local spread from the index case?

A. Likely - no secondary incidents have been detected. There are **no** further incidents as a result of spread tracings anywhere and **no** genotype/WGS linked OTF-W incidents within 3km radial zone around the LRA OTF-W incident herd in question (or the 3km radial surveillance zone was not triggered).

B. Possible - no secondary incidents have been detected, but the dataset is incomplete. For example, incidents have occurred in the 3km radial zone, but only OTF-S ones, or, if OTF-W, they were of an unknown/different genotype.

C. Not likely - secondary spread from the index case, or exposure to a common wildlife source has occurred. For example, OTF-W incidents have occurred in the 3km zone linked by genotype or WGS, or there is known wildlife infection in the area with this genotype/close WGS.

Table A5.1: Risk matrix of the veterinary assessment of the origin of, and potential for spread of infection from, all the new OTF-W incidents identified in 2019.

	Probability of isolated, sporadic ('one-off') incident, without secondary local spread from the index case (A, B, C)		
Probability of *M. bovis* infection introduced through cattle movements (1, 2, 3, 4)	A. Likely	B. Possible	C. Not likely
1. Definite			
2. Likely		1	1
3. Possible	1		1
4. Not likely			1

Appendix 6: herd incidence of TB in England

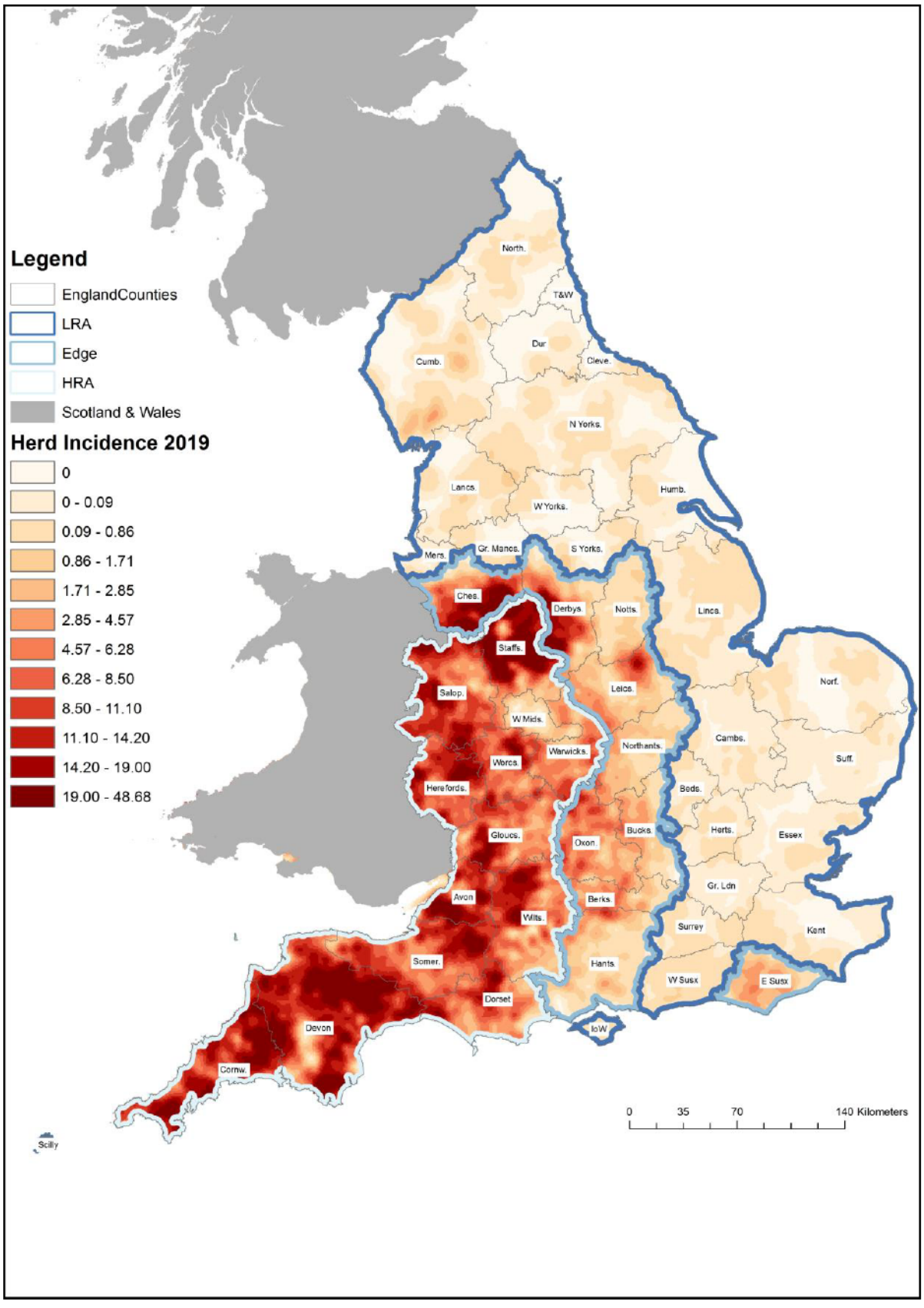

Figure A6.1: Herd incidence of TB in 2019 (incidents per 100 Herd Years at Risk), represented as a spatial kernel of the 100 closest herds per km^2.

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For information on how we handle personal data visit www.gov.uk and search Animal and Plant Health Agency Personal Information Charter.

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