Animal & Plant Health Agency

# Year-end descriptive epidemiology report:

## Bovine TB in the Edge Area of England

### County: Derbyshire

### Year-end report for: 2019

# Contents

# Executive summary

## Reporting area

Derbyshire is part of the Edge Area 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. The Edge Area has an overall moderate but recently rising incidence of infected herds with substantial variability from county to county. This end of year report describes bovine TB in Derbyshire.

## Local cattle industry

Derbyshire is a county of predominantly small herds of up to 50 cattle. There is a majority of beef herds (suckler and fattening), but with a significant proportion of medium to large dairy herds mostly situated in south and west Derbyshire. There are 12 non-grazing Approved Finishing Units (AFU), six Pre-movement Testing Exempt Finishing Units (EFU - two grazing, four non-grazing) and one cattle market operating in the county.

## New incidents of TB

The number of new TB incidents in Derbyshire decreased from 142 in 2018 to 114 in 2019. This decrease was mainly seen in Officially Bovine Tuberculosis Free Status Suspended (OTF-S) incidents from 58 in 2018 to 33 in 2019, while the number of Officially Bovine Tuberculosis Free Status Withdrawn (OTF-W) incidents remained similar at 81 in 2019 compared to 84 in 2018.

## Suspected sources and risk pathways for TB infection

Wildlife was considered to be the most likely source of infection for new incidents reported in Derbyshire in 2019 with badgers providing a weighted contribution of approximately 61% of all risk pathways. An additional 2% contribution came from other wildlife sources, such as wild deer. Movement of undetected infected cattle contributed to 17% of risk pathways and is the second main source of infection for TB incidents followed by recrudescence of a previous infection (10%). Contact with an infected contiguous cattle herd contributed to 3% of risk pathways, whilst there was a 5% weighting attributed to undetermined origins.

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 to the 2019 bovine TB epidemiology reports.

## Disclosing tests

The majority of incidents (91% of total) were disclosed by active on-farm surveillance testing. Routine, annual, whole herd surveillance testing disclosed 64 incidents, enhanced post-incident surveillance identified 25 incidents (24 at 6 month post-incident testing and one at 12 month post-

incident testing). A further seven incidents were detected by pre-movement testing, five by radial testing and one by contiguous testing. Passive (slaughterhouse) surveillance detected ten new incidents in 2019.

## Reactor numbers

In total, 1,291 cattle were compulsorily slaughtered for TB control in Derbyshire in 2019. Of these, 679 were skin test reactors and 612 were detected by interferon-gamma (IFN-γ) testing. Altogether, there was a slight increase in the number of animals removed for TB control compared to 2018, mainly due to IFN-γ test positive animals, while the number of skin test reactors did not change significantly (673 in 2018).

## Risks to the reporting area

Derbyshire is under constant risk of infection spread from the neighbouring High Risk Area (HRA) county of Staffordshire. Increased TB control measures in cattle might reduce the risk to Derbyshire, but continued spread of infected wildlife from the HRA seems inevitable without appropriate wildlife interventions.

## Risks posed by the reporting area

The main risk to the counties of the Low Risk Area (LRA) along the northern border of Derbyshire remains, as in previous years, in the area adjacent to Greater Manchester, West and South Yorkshire. The most likely infection pathway is via infected cattle movements, which is mitigated by statutory pre-and post-movement TB testing.

## Forward look

There are several measures that would help address the most common risk pathways for TB infection in Derbyshire. These include:

- incentivising the uptake of effective biosecurity measures
- managing the TB risks posed by cattle movements to reduce the risk of spread of TB within and between farms
- evolving the strategy for preventing the spread of TB from wildlife
- improving diagnostics, surveillance and epidemiology to root out TB more effectively

# Introduction

This report describes the level of bovine tuberculosis in cattle herds in Derbyshire 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 Derbyshire, 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 levels of TB in different parts of the country and to vary the approach to control accordingly. To this end three management areas were established (refer to Appendix 1). Derbyshire forms part of the Edge Area. Overall, the Edge Area has a moderate but recently rising incidence of infected herds with substantial variability from county to county. Control efforts are seeking to slow down and reverse geographic spread, and to reduce the incidence rate. The aim is to obtain OTF status for the Edge Area as soon as possible.

# Changes to the Edge Area in 2018

On 1 January 2018 the Edge Area boundary was expanded westwards to absorb the former High Risk Area (HRA) parts of the five previously split counties. Cheshire, Derbyshire, Warwickshire, Oxfordshire and East Sussex all moved fully into the Edge Area. Furthermore, the routine TB testing frequency of herds in the counties in the west of the Edge Area adjoining the HRA (or parts thereof) was increased from annual to six-monthly. The respective descriptive TB epidemiology reports for those five counties of the Edge Area will focus on the whole county and key differences between the old and new parts will be highlighted where relevant.

From January 2018 annual routine herd surveillance testing was replaced by six-monthly herd surveillance testing in the former HRA portion of Derbyshire. However since May 2019, cattle herds that meet certain criteria are eligible for annual surveillance testing (earned recognition). These criteria are either: 1) the herd has been in existence for at least six years and has not had a TB incident in that six year period or 2) the herd is registered to a bovine TB health scheme accredited under the Cattle Health Certification Standards (CHeCS) at level one or above.

# Cattle industry

## Herd types

Beef suckler and fattening herds are the predominant herd type in Derbyshire, with 54% of cattle being beef-sired (see Appendix 2). Beef suckler herds are almost equivalent in number to beef fattening herds. Both fattening and suckler herds can exist as very small units comprising fewer than ten animals, but suckler herd size can extend up to 500 animals, and with some fattening herds comprising over 1,000 animals. Dairy herds are less common, but still well represented in the county (40% of cattle are dairy-sired). Most dairy herds are medium to large in size (100–1,000 cattle) with larger herds typically located in south and west Derbyshire.

Overall, there is a predominance of small herds of up to 50 cattle in Derbyshire as shown in Figure 1. It would be reasonable to assume that the majority of these small herds are beef fatteners or beef sucklers.

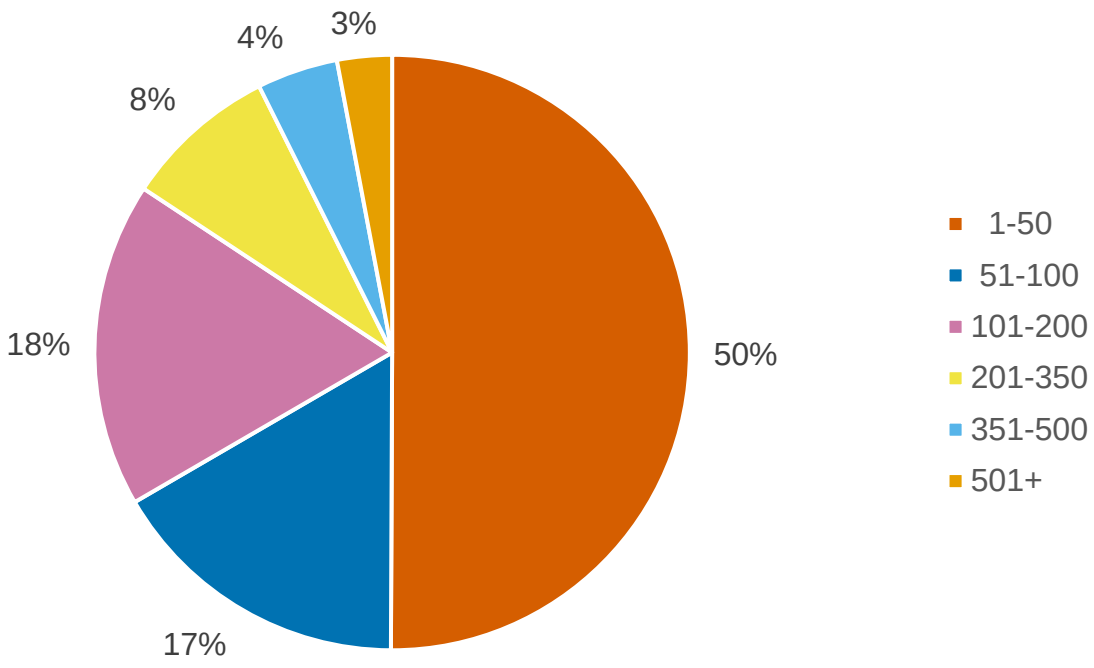


Figure 1: Proportion of cattle holdings by herd size in Derbyshire in 2019 (n=1546).

## Markets

There is one livestock auction market in Derbyshire (Bakewell). Many farmers, particularly in south and west Derbyshire also utilise the livestock market in Leek, which is situated in the adjacent HRA county of Staffordshire. This facilitates the flow of cattle from the HRA to the Edge Area and potentially provides opportunity for spread of TB to Derbyshire. Bakewell market operates pre-movement testing exempt sales and Leek market operates approved slaughter gatherings, both of which are subject to specific TB licensing and controls. This mitigates the risk of TB transmission by

cattle moving through these gatherings, as only onward movements of cattle directly or indirectly to slaughter are allowed.

## Approved Finishing Units

Two additional Approved Finishing Units (AFUs) for TB-restricted cattle were approved in Derbyshire in 2019 giving a total of twelve AFUs in the county. These units are all non-grazing (as required in the Edge Area) and, if correctly operated, are not considered a risk for introduction or spread of TB into the surrounding areas.

The number of pre-movement testing Exempt Finishing Units (EFUs) remains the same in 2019 at a total of six units, two of which are with grazing and four of which are non-grazing.

## Common land

There are some small areas of common land in Derbyshire, with low numbers of cattle grazed and no significant co-grazing by more than one herd, so spread of TB related to common land usage is unlikely in this county.

# Descriptive epidemiology of TB

## Temporal TB trends

Three measures are used to explore the level of TB in this report.

1. The number of new herd incidents that were disclosed in each year.

2. The annual herd incidence rate, reported as the number of new incidents per 100 herd-years at risk (100 HYR). This is the number of new TB incidents detected in the year, divided by the time those herds were at risk of contracting TB. The 100 HYR incidence rate is used in this report as it accounts for different intervals between herd tests that other incidence measures do not (such as new TB incidents per number of herds or tests).

3. The annual end of year herd prevalence. This is the number of herds under restriction due to a TB incident, divided by the number of active herds at the same point in time. Prevalence provides a snap shot of the burden of TB on the local cattle industry.

All three measures include 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) inspection, 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 inspection or bacterial culture. TB incidents in

non-grazing AFUs are not included in the prevalence and incidence calculations in this report due to the limited epidemiological impact of these cases. Furthermore, herds restricted because of an overdue test rather than a TB incident are also excluded from calculations. Hence measures of incidence and prevalence in this report may be lower than those reported in the official TB statistics.

There have been fluctuations in the annual number of infected herds over the last ten years in Derbyshire. In the whole county (Figure 2), the number of new incidents increased sharply from 112 in 2010 to 153 in 2012, then decreased and stabilised between 2013 and 2017 (averaging 118 incidents per year during this time period). Another sharp increase to 142 incidents in 2018 was followed by a decrease to 114 in 2019. This decrease was mainly observed in the number of OTF-S incidents which dropped from 58 in 2018 to 33 in 2019, while the number of OTF-W incidents in 2019 (81) remained similar to the previous year (84).

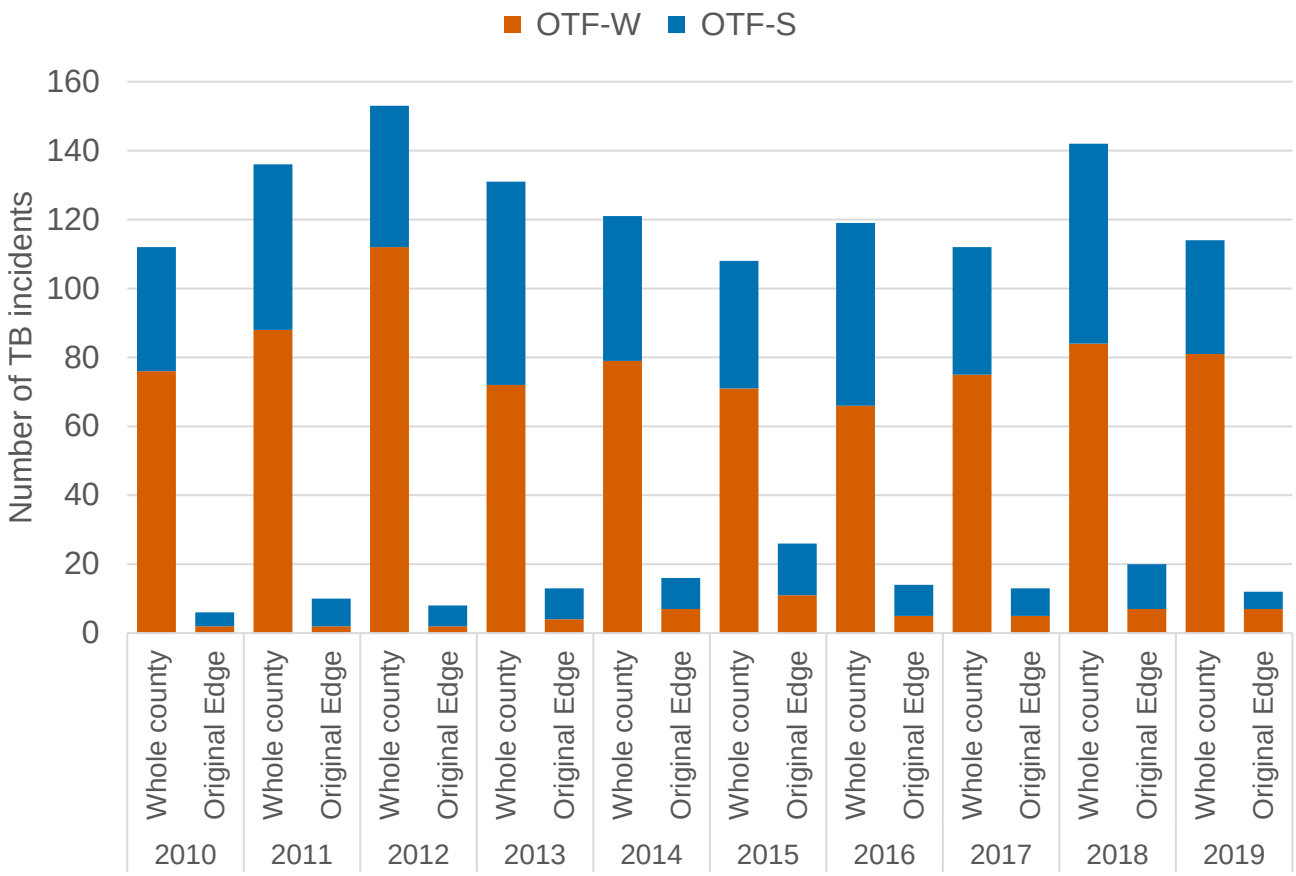


Figure 2: Annual number of new TB incidents in Derbyshire, 2010 to 2019, showing incidents for the whole county and the original Edge Area.

In 2018, following the expansion of the Edge Area in Derbyshire to include the whole county, the frequency of routine surveillance testing increased from annual to six monthly in the former HRA portion of the county. This has resulted in earlier detection of disease in some of these herds and may partly explain the significant increase in the number of new incidents detected in 2018 and the subsequent reduction during 2019. However it is too early to draw more meaningful conclusions about the impact of increased surveillance testing frequency in this county.

The majority of cattle incidents in Derbyshire have occurred in the former HRA portion. This area is larger than the original Edge Area, both in geographical area and numbers of cattle and cattle herds. In the original Edge Area portion of the county, the annual number of new incidents has remained at 20 or fewer per year apart from in 2015. The spike in 2015 (26 cases) was caused by the disclosure of a group of new incidents in north-west Derbyshire and not directly related to any change in cattle test frequency across the original Edge Area portion. These incidents were discussed in previous reports and updated in this report (see section on Geographical distribution of TB incidents).

This fluctuating pattern over the last ten years is similarly reflected in the annual herd incidence rates shown in Figure 3. In addition, the annual herd incidence rate (incidents per 100 herd-years at risk) in the whole of Derbyshire has seen an increase in 2019 (9.3) compared to 2018 (8.2), while it has dropped in the original Edge Area of Derbyshire (5.0 in 2018 to 3.3 in 2019). The denominator for this incidence rate measure is sensitive to changes in testing intervals within an area. This should be borne in mind when considering incidence rate trends in some parts of the Edge Area that moved from annual to six-monthly testing in 2018. An alternative incidence measure is incidents per 100 unrestricted herds. For the whole county this measure shows a decrease from 9.1 in 2018 to 7.6 in 2019. For the original Edge area of the county there was also a decrease in 2019 (3.1) from 2018 (5.0). A detailed description of the methodology used to calculate incidence is available in the Explanatory Supplement for 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

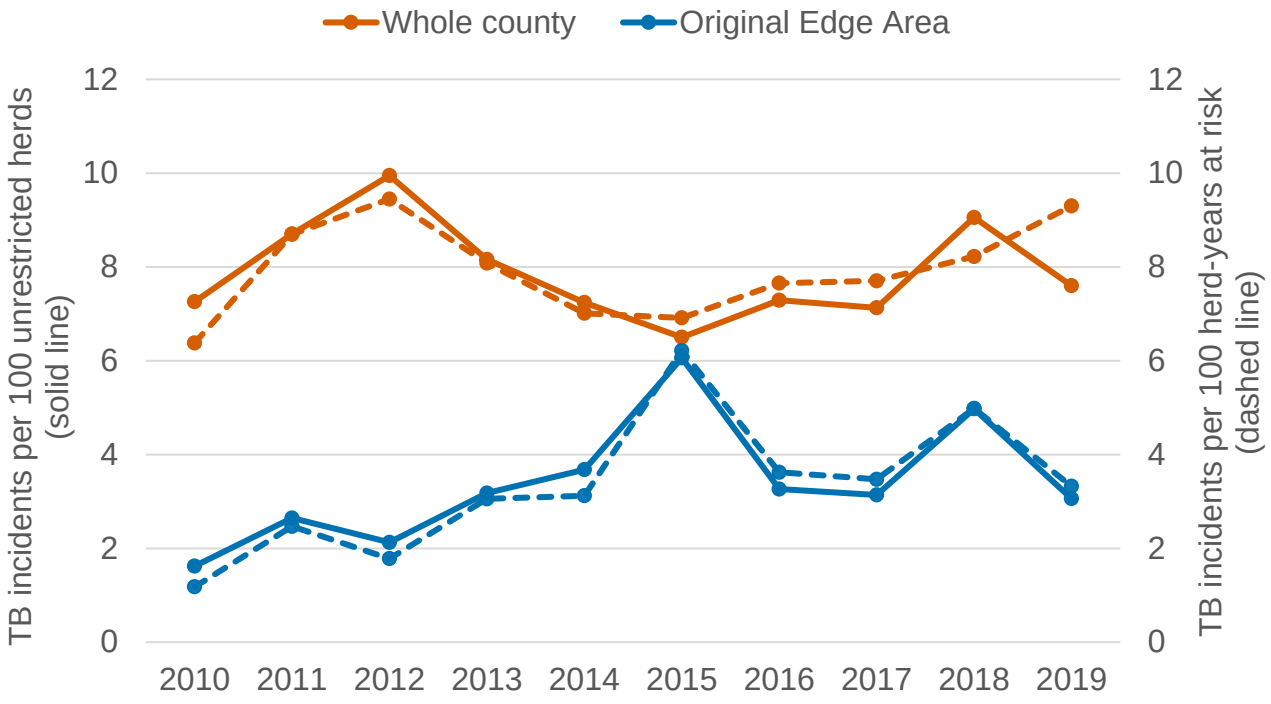


Figure 3: Annual herd incidence rate (per 100 herd-years at risk and per 100 unrestricted herds) for all new incidents (OTF-W and OTF-S) in Derbyshire, 2010 to 2019, showing data for the whole county and for the original Edge Area.

Annual end of year herd prevalence reflects the percentage of herds in Derbyshire which were subject to movement restrictions (due to TB infection in the herd) at the end of each year and takes into account both existing and new incidents. The duration of TB incidents can therefore have a direct effect on prevalence; the longer the incident duration, the higher the end of year prevalence.

Over the past ten years, as shown in Figure 4, the herd prevalence in the whole county of Derbyshire reached an initial peak of 5.22% in 2012 and then dropped to 2.66% in 2015 (the lowest herd prevalence recorded since 2010). Thereafter, there was a year on year increase until a second peak of 5.62% in 2018. By the end of 2019, the herd prevalence in the whole county had declined to 4.80%.

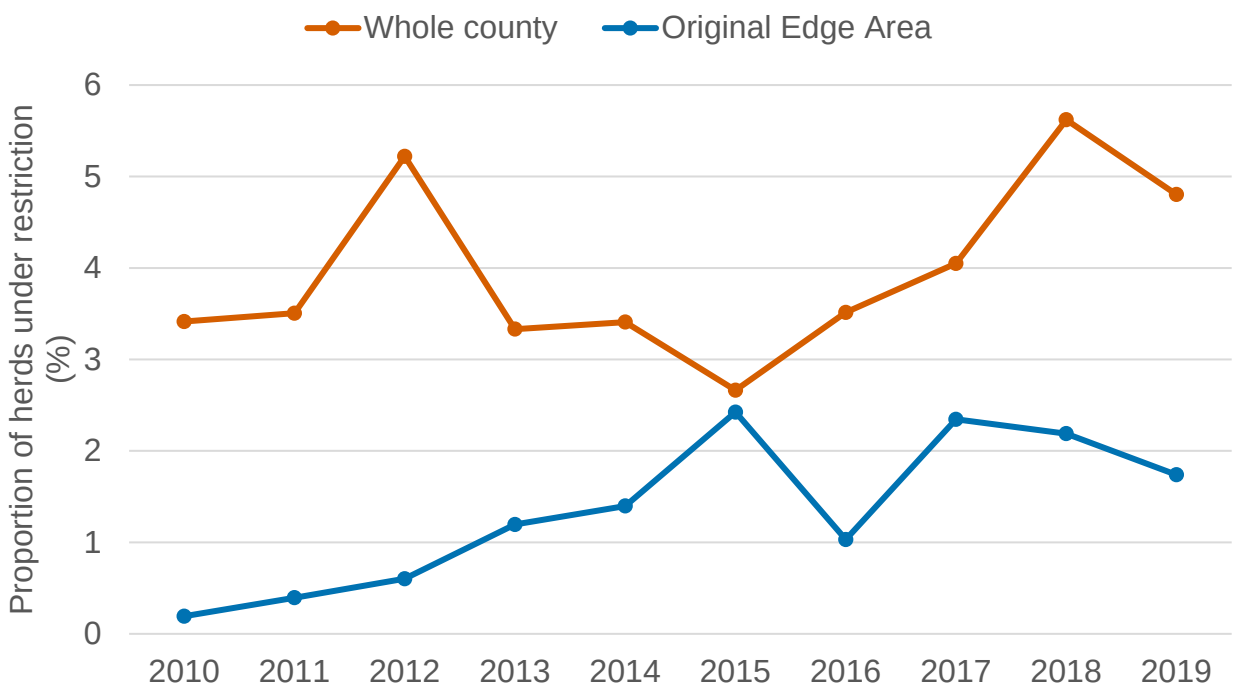


Figure 4: Annual end of year TB herd prevalence in Derbyshire, 2010 to 2019, showing data for the whole county and for the original Edge Area.

The more recent increases in whole county herd prevalence may have been driven by prevalence increases in the former HRA portion of Derbyshire. TB is endemic in this area where constant reinfection from wildlife sources and the presence of residual infection in some herds is often the cause of prolonged incidents and makes it difficult to resolve herd infections.

The decrease in herd prevalence in 2019 may have occurred as a result of earlier detection of disease due to more frequent cattle testing, leading to a shortening of the duration of incidents. However it is too early to predict a reducing trend in herd prevalence in Derbyshire.

In summary, the above figures illustrate that Derbyshire is unlikely to be eligible for OTF status by 2025 as set out by the criteria for the Edge Area in the Strategy for achieving OTF status for England published in 2014.

## Geographical distribution of TB incidents

The 2019 whole county herd incidence rate (incidents per 100 herd-years at risk) in Derbyshire was 9.3 (Figure 5). This is slightly below the Edge Area average of 9.9, and well below the average herd incidence in the HRA (16.9). Derbyshire has a higher cattle herd density than all other Edge Area counties, apart from Cheshire. A lower incidence rate in cattle dense counties is not necessarily reflective of the actual burden of disease (number of herd incidents and numbers of cattle removed as reactors and direct contacts) in that county.

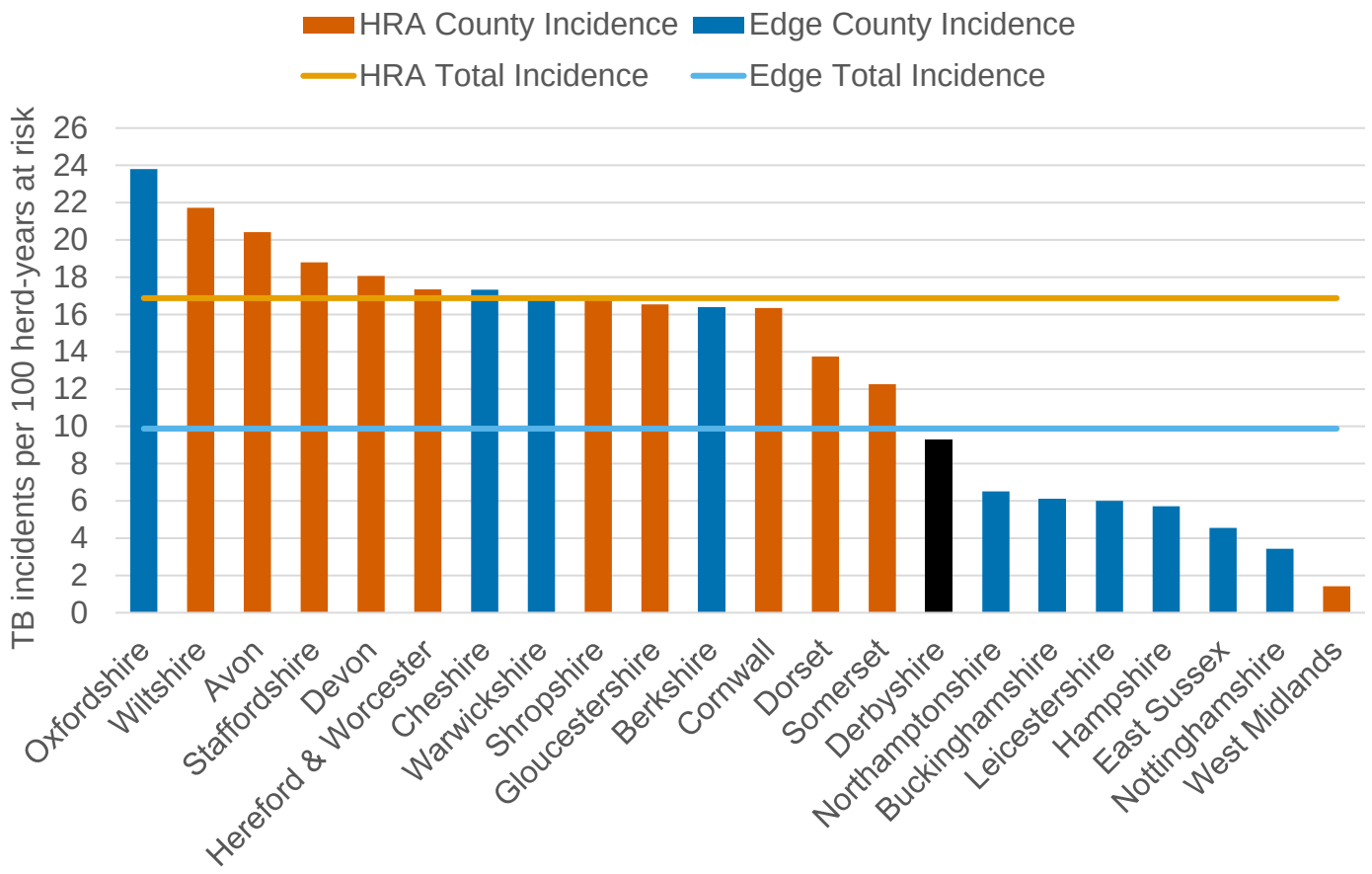


Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in 2019, by HRA and Edge Area County.

The geographical distribution of existing and new TB incidents in 2019 and their associated spoligotype of *M. bovis* is shown in Figure 6. Similar to 2018, the distribution and density of new and existing incidents appears to be concentrated mainly in the south and west of the county (former HRA portion), mirroring the higher density of cattle holdings in these areas. Although there were fewer new incidents disclosed in 2019 compared to 2018, incidents are increasingly occurring further east towards central Derbyshire. In 2019 a group of three new OTF-S incidents were disclosed in north Derbyshire, bordering the LRA county of South Yorkshire. The cluster of incidents in the north-west of Derbyshire, first recorded in 2015, has remained in existence throughout the intervening years. Five new OTF-W and two OTF-S incidents, with wildlife being regarded as the most likely source of

infection, were identified in this area in 2019. This suggests that there is persistence of disease in the area, with some evidence of possible spread further north.

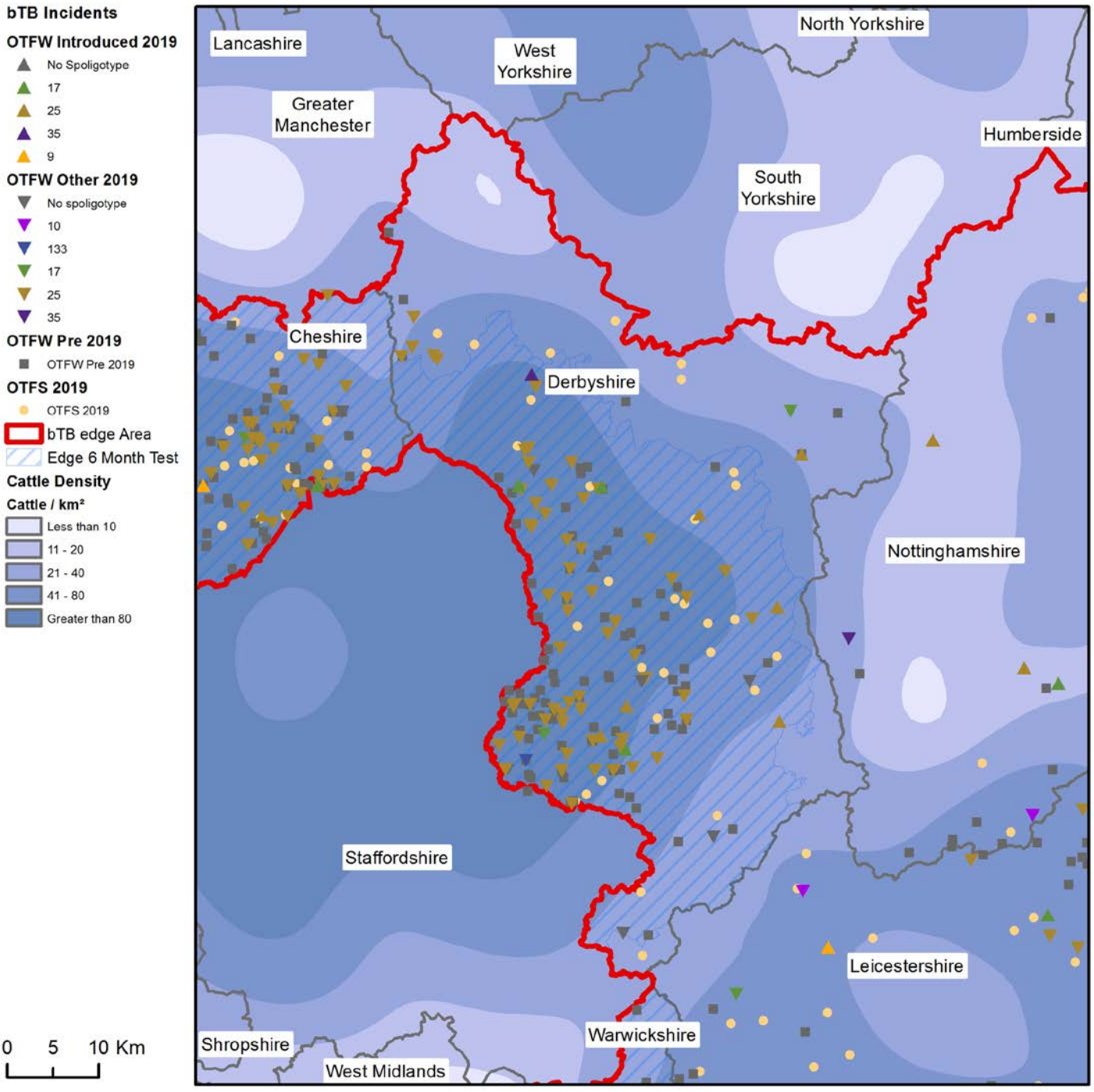


Figure 6: Location of cattle holdings in Derbyshire with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the beginning of 2019, overlaid on a cattle density map. To note, 'OTF-W Introduced 2019' refers to OTF-W incidents in which introduction of infection through cattle movements was the most likely source identified.

The geographic distribution throughout Derbyshire of TB incidents with likely wildlife involvement (Figure 7) shows that, as observed in 2018, there is clustering of incidents to the west and south of Derbyshire which corresponds to the former HRA portion of the county along the border with Staffordshire (HRA). The area is dominated by incidents with *M. bovis* genotypes 25:a and 25:b which are endemic in these parts of Derbyshire.

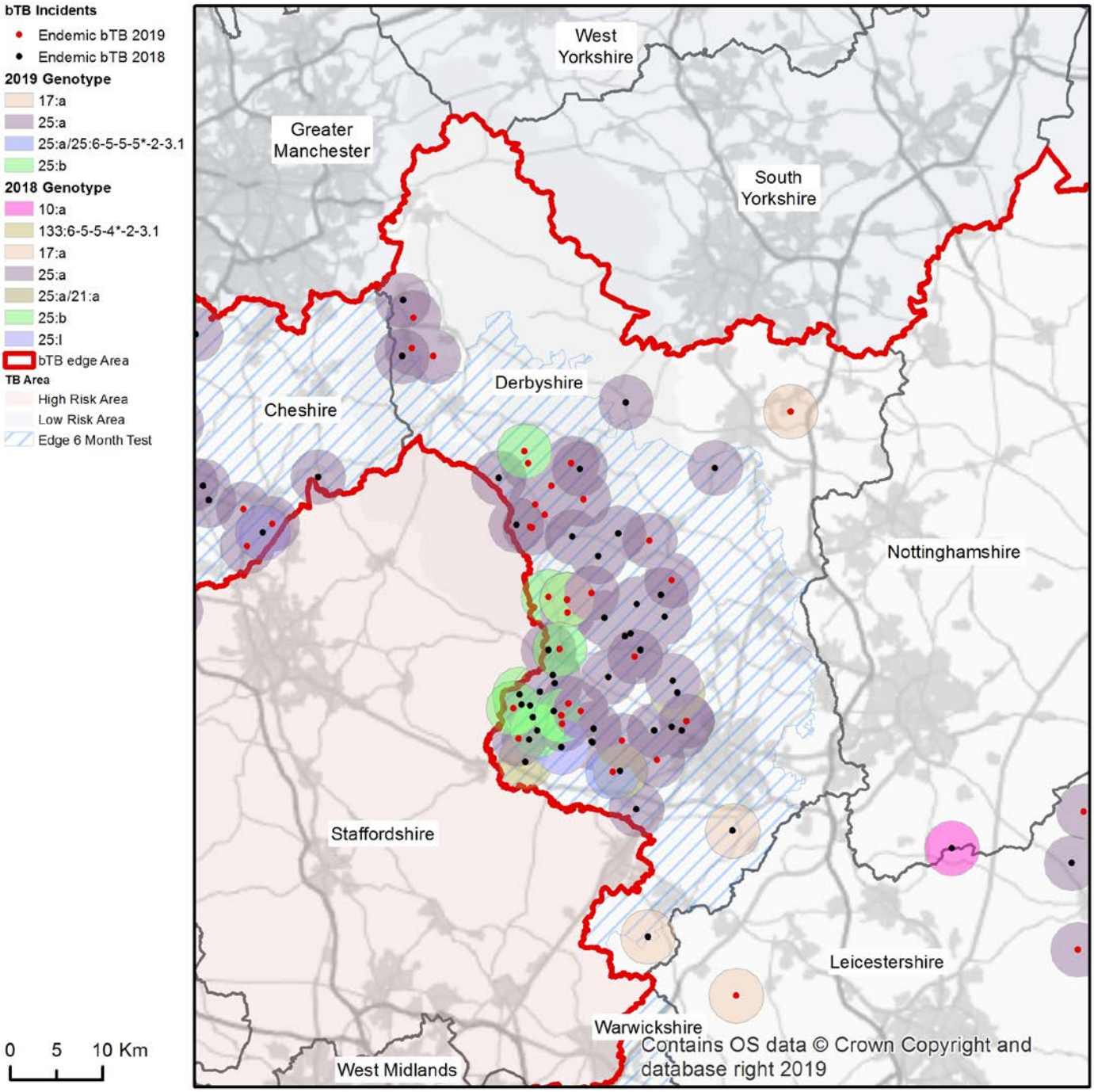


Figure 7: Genotypes of *M. bovis* detected in Derbyshire in 2018 and 2019, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemic infection within local wildlife populations (OTF-W incidents only).

Based on the most likely source recorded for all new incidents in 2019, there is a distinct abundance of incidents attributed mainly to a wildlife infection source in the south and west of Derbyshire (Figure 8). There are fewer incidents attributed to the movement of infected cattle and those are distributed throughout the county. The incidents attributed to local cattle-to-cattle spread via nose-to-nose contact with or straying from neighbouring cattle herds are concentrated in the areas with higher cattle density. Some sources are undetermined and this may be due to the fact that the incident is not yet resolved and/or there are insufficient data available.

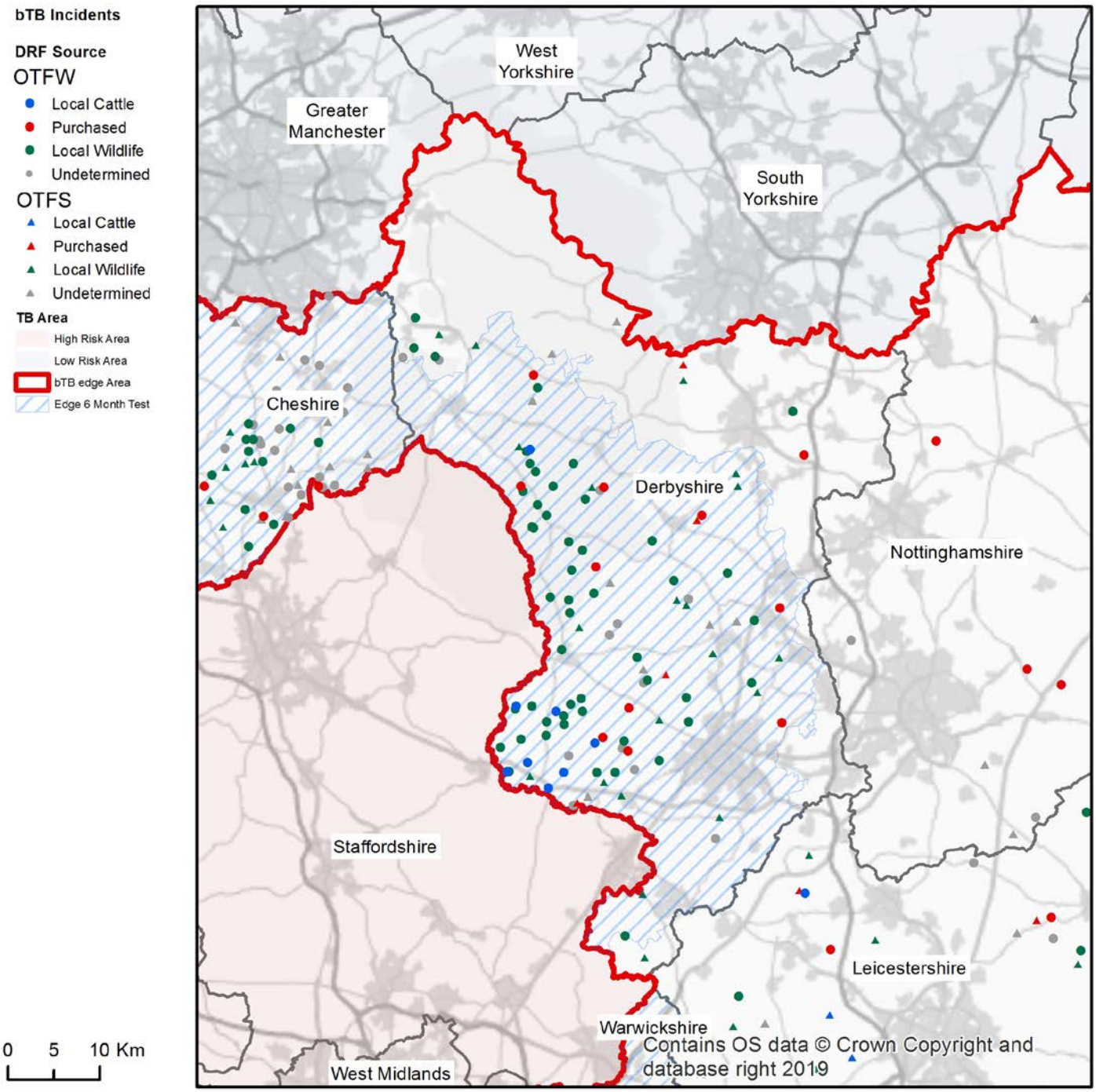


Figure 8: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Derbyshire, and its adjoining Edge Area counties, which started in 2019.

# Other characteristics of TB incidents

## Incidents by herd types

As for 2018, 45% of all TB incidents in 2019 occurred in dairy herds with 51 incidents out of 114 (Figure 9). Beef suckler herds accounted for 37% of incidents (42) followed by beef fatteners which represented only 18% of incidents (20) as opposed to 29% recorded in 2018 (42).

The largest number of incidents (31) occurred in the 101-200 herd size group which represents 18% of all herds. This contrasts with the 17 incidents disclosed in small herds of up to 50 cattle which represent 50% of all herds in Derbyshire. There is a clear trend of infection risk increasing in proportion to the size of the herd. Larger herds are therefore more likely to have an incident. This partly explains the higher occurrence of incidents in dairy herds (which are normally large herds).

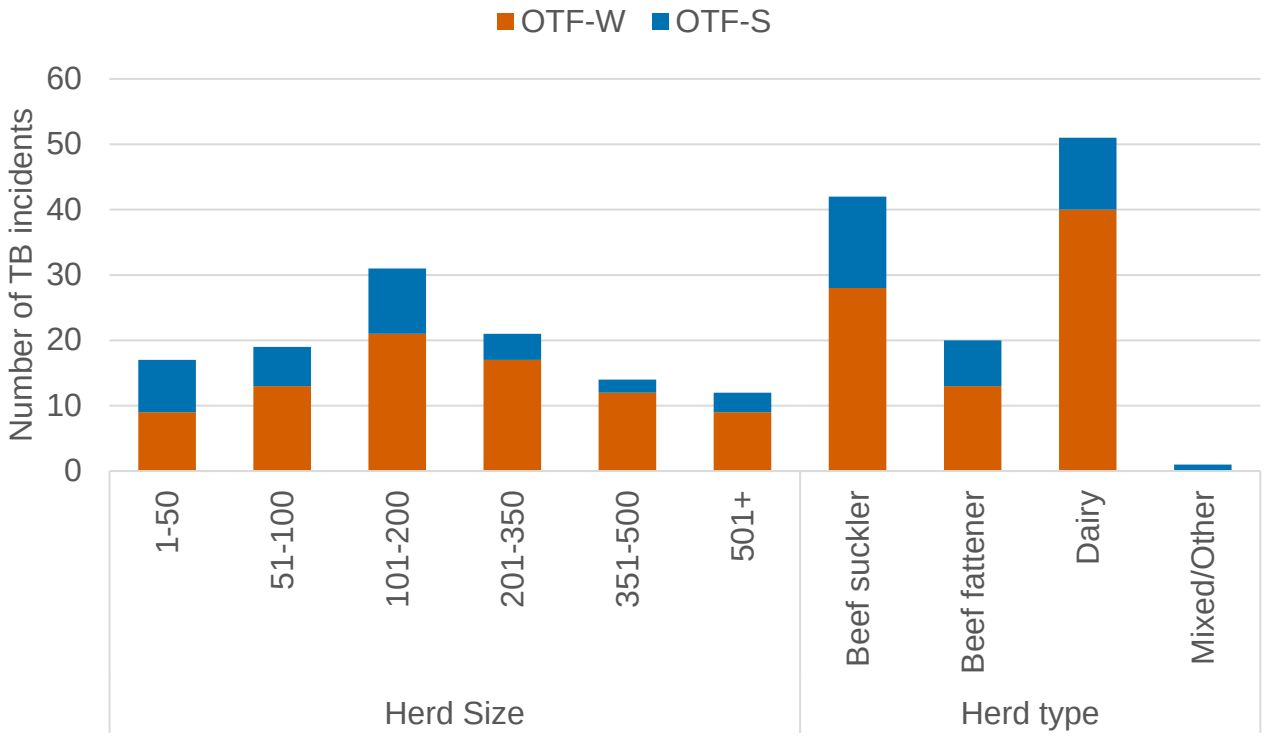


Figure 9: Number of new TB incidents (OTF-W and OTF-S) in Derbyshire in 2019, by cattle herd size and type.

## Incidents by month of disclosure

The numbers of incidents disclosed in Derbyshire by month, from January to December 2019 is shown in Figure 10. Generally there were relatively high rates of disclosure during the winter months compared to the summer apart from a peak in August with 16 incidents disclosed. New incidents may be more likely to be disclosed late in the winter (November, December, and January) simply because more tests are conducted during these months when cattle are housed. Greater rates of disclosure during the winter may partly be a result of cattle becoming infected at pasture. Cattle-to-cattle transmission of TB is likely to increase during winter housing when there may be relatively higher

stocking densities of cattle. On the whole, the implementation of six-monthly surveillance testing which replaced annual herd testing in the former HRA portion of Derbyshire in January 2018, has contributed to a more even distribution of incident disclosure throughout the year.

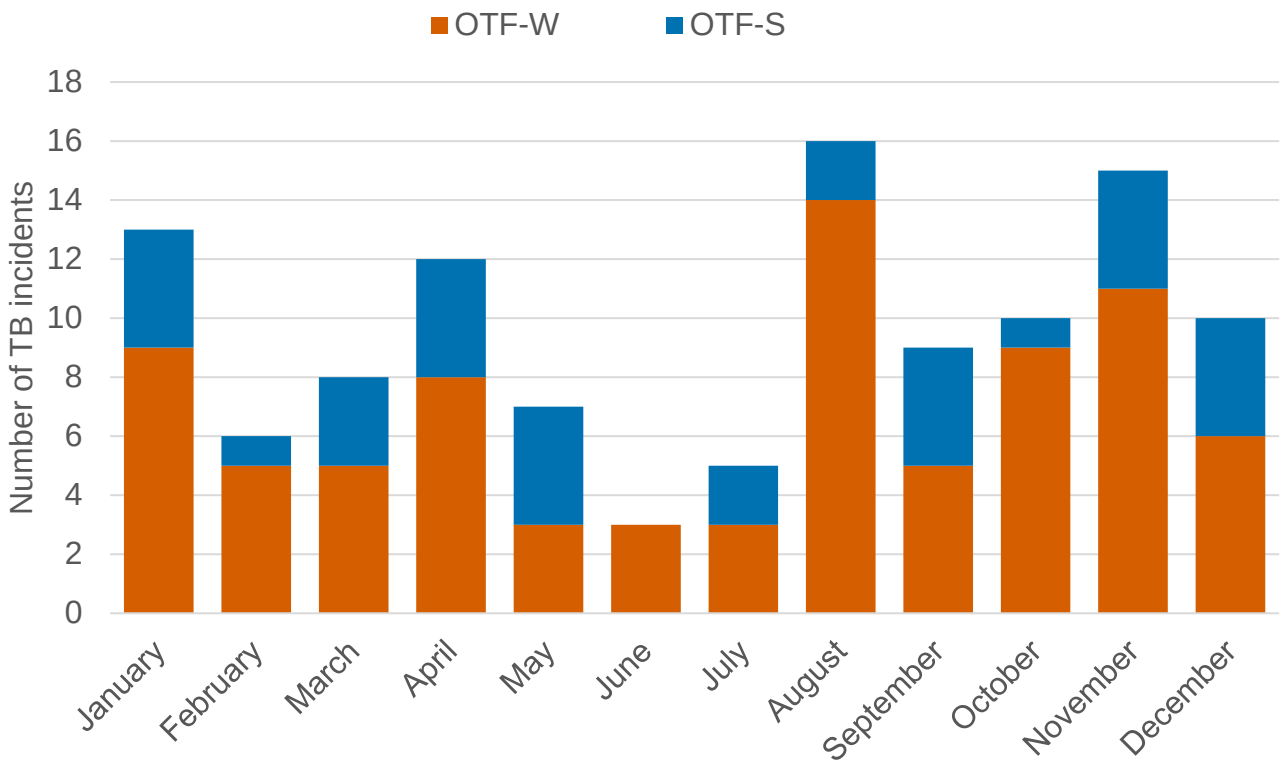


Figure 10: Number of new TB incidents (OTF-W and OTF-S) in Derbyshire in 2019, by month of disclosure.

## Genotypes of *M. bovis* isolated

Genotypes of *M. bovis* identified in cattle herds that sustained new OTF-W incidents in Derbyshire in 2019 are shown as a percentage in Figure 11. Genotype 25: a is the most common in Derbyshire representing 55 of the 74 isolates obtained in 2019. This equates to 74% of all genotypes identified in 2019. The homerange for genotype 25:a includes the former HRA portion of Derbyshire and so would be expected to be the dominant genotype.

Genotype 25:b is the second most common with 10 occurrences (14%) followed by genotype 17:a with five occurrences (7%). This is similar to the data for 2018. Genotype data can be used to help determine the probable geographical origin of infection for herds, particularly where cattle have been purchased from non-local farms. However, genotype 25:a has an extensive homerange including not only Derbyshire but also the neighbouring counties of Staffordshire and Cheshire, and parts of Shropshire and Leicestershire. For this reason, it can provide less information regarding source of infection compared to genotypes with much smaller homeranges (such as genotype 25:b) because infections with genotype 25:a can be acquired locally or from these neighbouring counties via cattle movements.

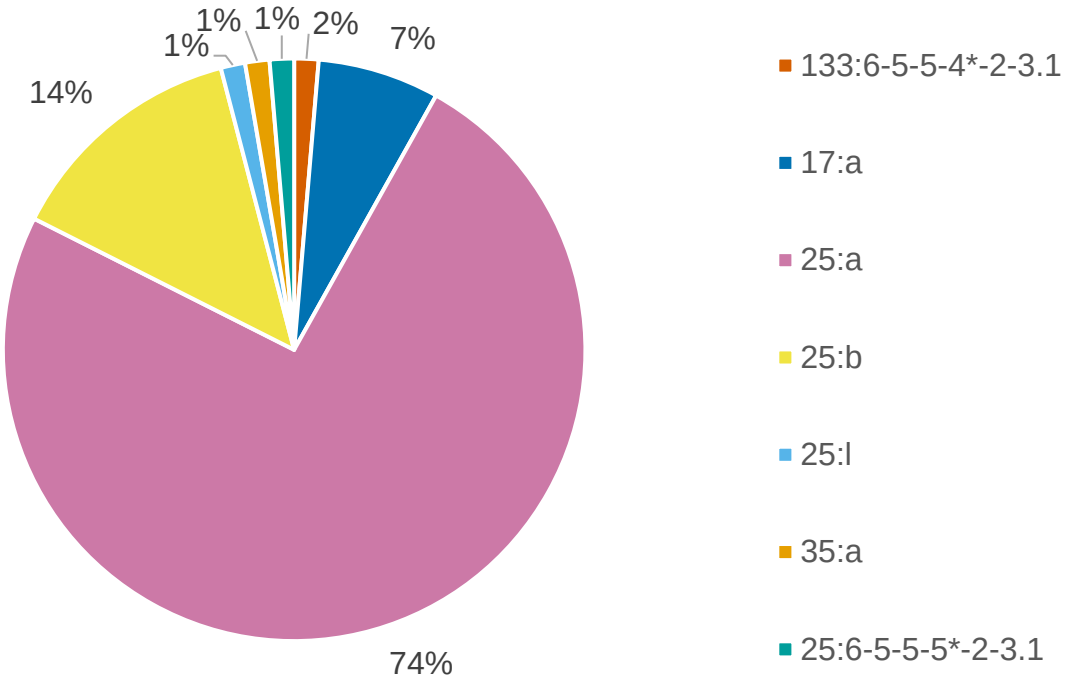


Figure 11: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Derbyshire in 2019 (n=74).

## Duration of incidents

The majority (56%) of all TB incidents resolved in 2019 had a duration of 151 to 240 days (Figure 12). For the 86 OTF-W incidents which closed in 2019, the average duration was 269 days, which was similar to 2018. The median OTF-W duration was 241 days compared to 236 days in 2018. The 44 OTF-S incidents which closed in 2019 had an average duration of 197 days and a median of 183 days.

There were nine persistent TB incidents (those with a duration of over 18 months) in 2019. Four of these were resolved during 2019 and had a duration of 578 to 641 days. Three incidents occurred in large dairy herds and one in a large beef suckler herd. All four herds were located in the former HRA portion of the county and infection was most likely to have come from infected badgers. The remaining five ongoing persistent incidents all started in 2018 and affect large herds (dairy, beef suckler, and fattening).

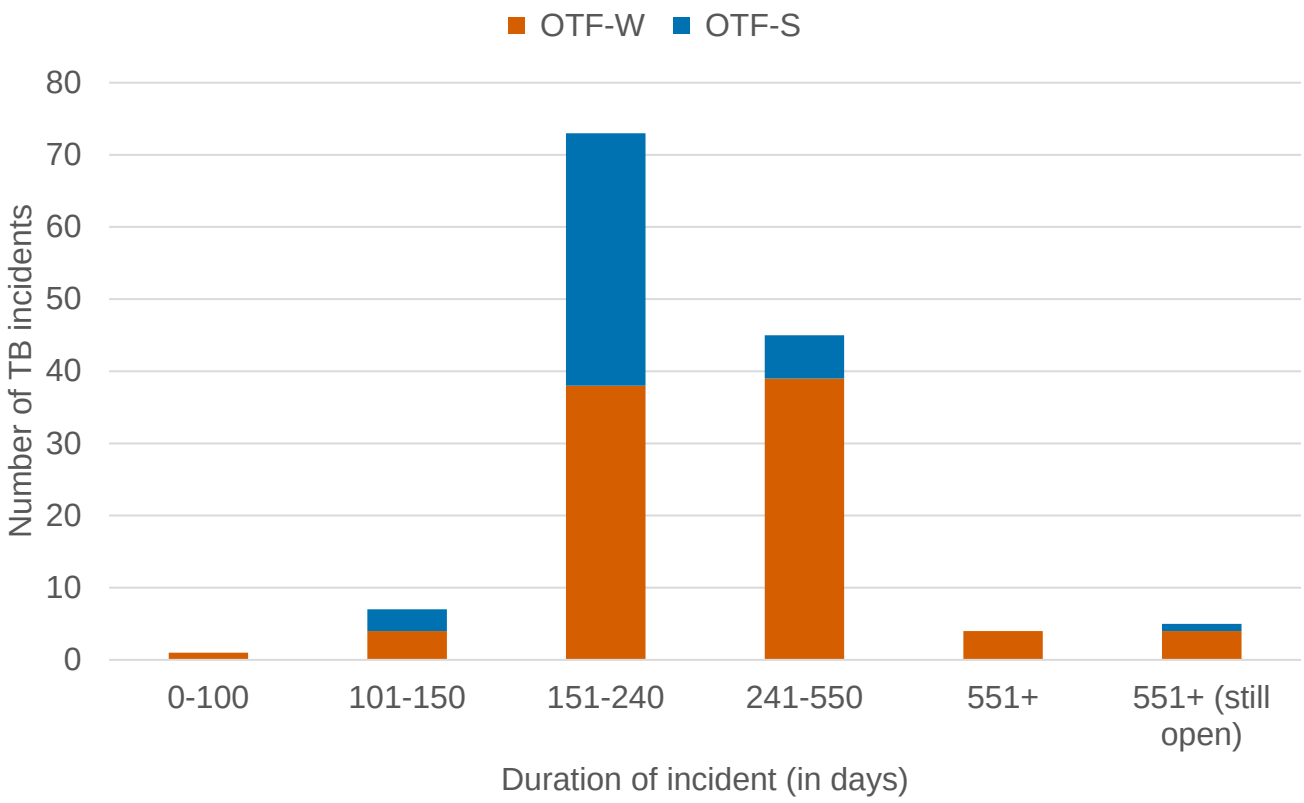


Figure 12: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Derbyshire. Note that Approved Finishing Units (AFUs) have been excluded.

## Suspected sources, risk pathways and key drivers for TB infection

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 Edge Area (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 sources 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 for 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

## Key drivers of infection

The key drivers of the TB epidemic within Derbyshire are as follows:

- Infected wildlife
- Cattle movement and risk from the HRA
- Residual infection

Badgers are deemed to be a significant source of TB in the county as they act as reservoirs of infection and transmit TB to cattle. Other wildlife sources such as wild deer may also play a role but are not considered to be a primary driver of infection. The frequency of detection of genotype 25:a within incidents attributed to wildlife as seen previously in Figure 7 is an indication of TB endemicity within the local wildlife population. This is a crucial driver of the epidemic in the county, particularly since there are currently limited measures applied to control TB within the wildlife population. The TB Advisory Service (TBAS, www.tbas.org.uk/) launched in October 2017 which offers free bespoke advice to farmers on TB biosecurity, has encouraged a greater awareness and understanding of limiting contact between cattle and badgers.

Cattle movement is the second most important driver of the TB epidemic in Derbyshire. Bringing animals into a herd will always carry a risk of introducing any disease, not just TB. However, restocking and purchase of animals is important to most farm businesses, and the risk associated with them can be reduced to a minimum by adopting best practice. The use of livestock markets in the neighbouring HRA counties leads to a risk of disease dissemination to Derbyshire via the movement of cattle with undetected infection. Furthermore, it is becoming increasingly difficult for farmers to locally source cattle from holdings with no recent TB history. Services like the TB Advisory Service (TBAS, www.tbas.org.uk/), Farm Level TB reports issued by APHA during incidents and other tools introduced to encourage safe sourcing of cattle like the interactive mapping tool, ibTB (www.ibtb.co.uk) have all proven useful and of interest to farmers. However, further collaboration between industry, government and private veterinarians is needed for the message to be embraced by the wider farming community.

Residual infection in herds causing recurrence of TB is the third most important and challenging driver of the TB epidemic in Derbyshire. Residual infection refers to the presence of animals in a herd which harbour infection which was undetected by testing during a previous herd incident. Current diagnostic tools (including use of the IFN-γ test) are not always able to identify all infected animals

within known infected herds, however APHA continues to quality assure the delivery of TB skin testing by official veterinarians to maximise disclosure of infected herds.

## Sources of infection and risk pathways

As illustrated in Figures 13a and 13b, wildlife continues to be the most likely source of infection reported in Derbyshire in 2019. Badgers as a source of infection were considered to be relevant in 61% of all pathways considered, with similar weighting for OTF-W (62%) and OTF-S (60%) incidents. This is a reduction compared to the 77% recorded in 2018 and is partly due to a refined mathematical algorithm used to determine the relative contribution of different sources for each incident in this reporting year. In line with the discussion in the previous section (Figures 7 and 8), the high proportion of incidents with badger involvement (this includes cattle exposure at grazing as well as at housing) reflects the endemicity of TB within the local wildlife population in the former HRA portion of Derbyshire. This reinforces the need for increased biosecurity along with appropriate wildlife controls in order to stop the spread of TB through Derbyshire. Involvement of other wildlife sources of infection such as wild deer were attributed in 2% of OTF-W incidents and for 4% of OTF-S incidents. This coincides with areas where there is a large population of wild deer (mostly red deer) near the Goyt Valley and Big Moor. Additionally, once detected, infection in wild deer is often controlled locally by additional culling. Wild deer surveillance is carried out by private stalkers who are aware of the need to submit tissue samples from carcases with typical lesions of TB for bacteriological culture. Where there is a suspicion of deer-related TB infection in cattle, this surveillance can be intensified and additional surveillance of cattle in an area can be initiated by APHA when considered appropriate. APHA continues to monitor the results of surveillance in wild mammals and there was no laboratory confirmed isolation of *M. bovis* in wild deer in Derbyshire in 2019.

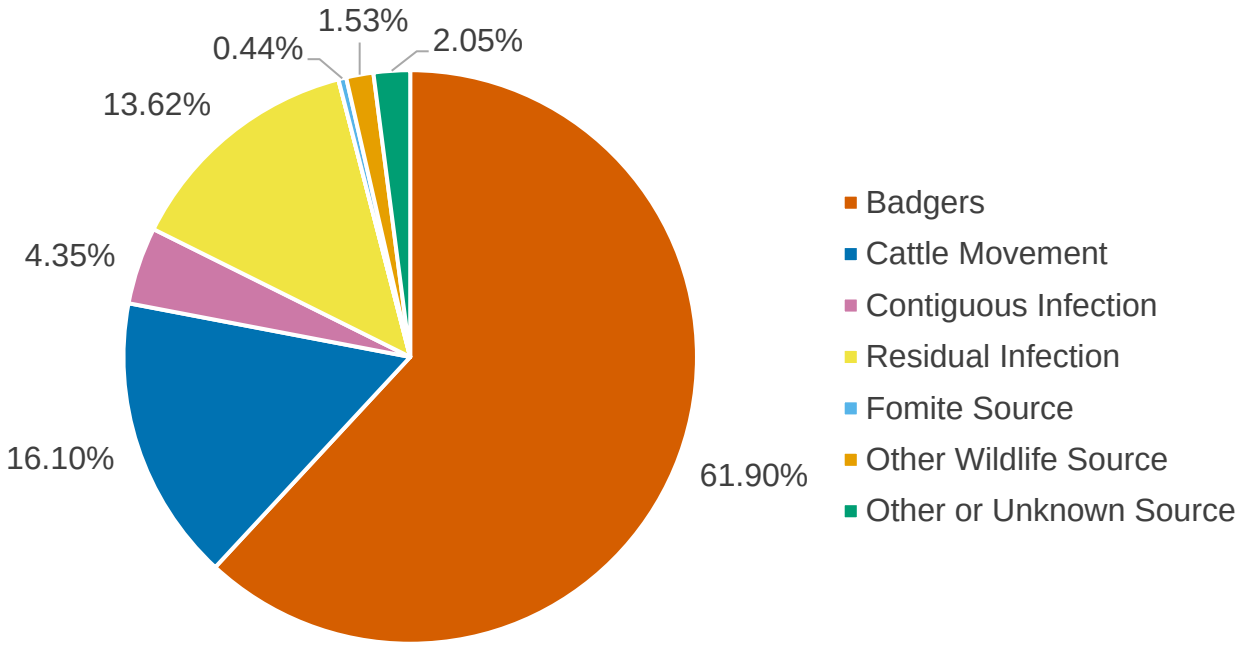


Figure 13a: Summary of the weighted source of infection pathways attributed for all OTF-W incidents in Derbyshire that started in 2019, that had a completed DRF (73).

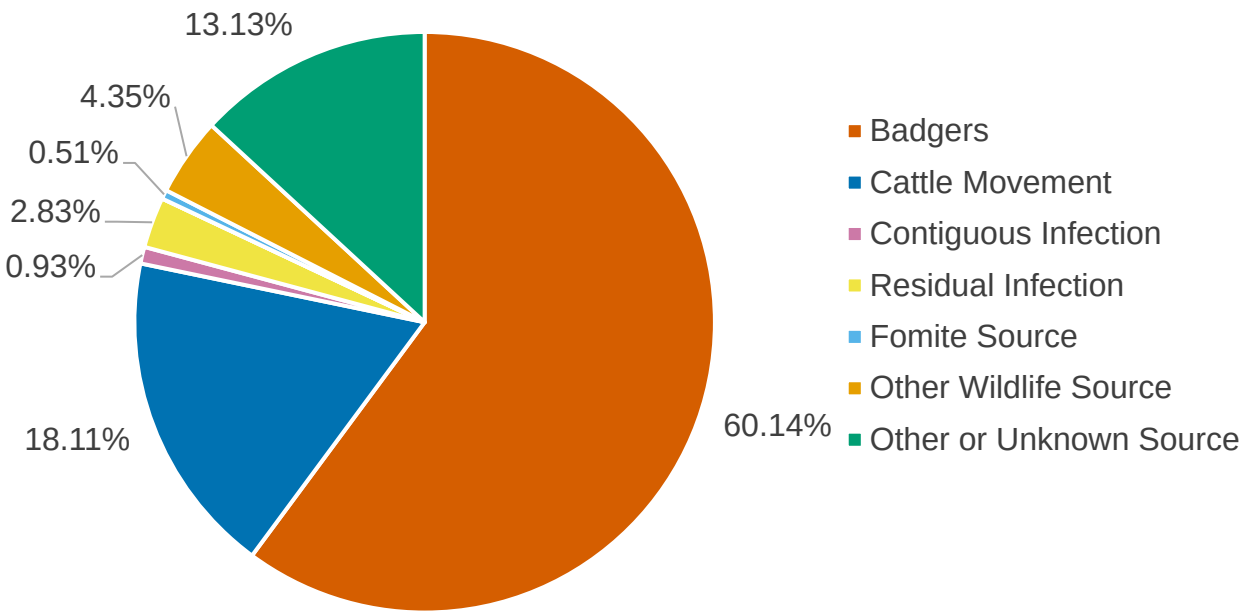


Figure 13b: Summary of the weighted source of infection pathways attributed for all OTF-S incidents in Derbyshire that started in 2019, that had a completed DRF (33).

Movement of undetected infected cattle was identified in 16% of risk pathways for OTF-W incidents and 18% of risk pathways for OTF-S incidents in 2019, an increase compared to the 10% recorded in both OTF-W and OTF-S incidents in 2018. With Derbyshire being contiguous to the HRA county of Staffordshire, it is to be expected that cattle movements are a source of TB infection to Derbyshire as many farmers try to source their cattle locally. There is also the possibility that, given that three quarters of the genotypes detected are 25:a (see Figure 11) and that 25:a has an extremely large geographical distribution, some cases where disease spread is classified as local cattle spread could have been brought into the county by cattle moved within the homerange of this genotype, therefore obscuring the contribution of cattle movements to the epidemic.

Residual infection from a previous incident was the third most likely source of infection reported in Derbyshire in 2019, liable for 14% of pathways identified in OTF-W incidents. A small proportion of pathways in OTF-S incidents (3%) were considered to be due to residual infection. Difficulties in clearing disease from infected herds, leading to recurrent incidents, is a key challenge to TB eradication and this is of particular concern as infected animals can pose a future infection risk to the index or neighbouring herds, or to herds to which the animal may subsequently move.

Similar to 2018, only 3% of pathways identified in OTF-W and OTF-S incidents were attributed to nose to nose contact with infected neighbouring cattle. This risk pathway is much less frequently observed now as farmers are more aware of the need to separate their cattle from other herds due to the risks of contracting other diseases as well as TB. Many do not graze cattle in adjoining fields or may use paddock rotation to avoid cattle being in contiguous fields at the same time.

The source of infection in approximately 5% of pathways in all new incidents in 2019 remained unknown (2% of OTF-W and 13% of OTF-S). This may indicate that either the incident was not yet resolved within the reporting year or there were insufficient data available to determine the source of infection (usually OTF-S incidents where genotypes are not available).

The source of infection recorded with the highest level of certainty for all incidents in Derbyshire in 2019, by herd type reiterates how wildlife seems to play a key role in both beef (suckler and fattening) and dairy herds (Figure 14).

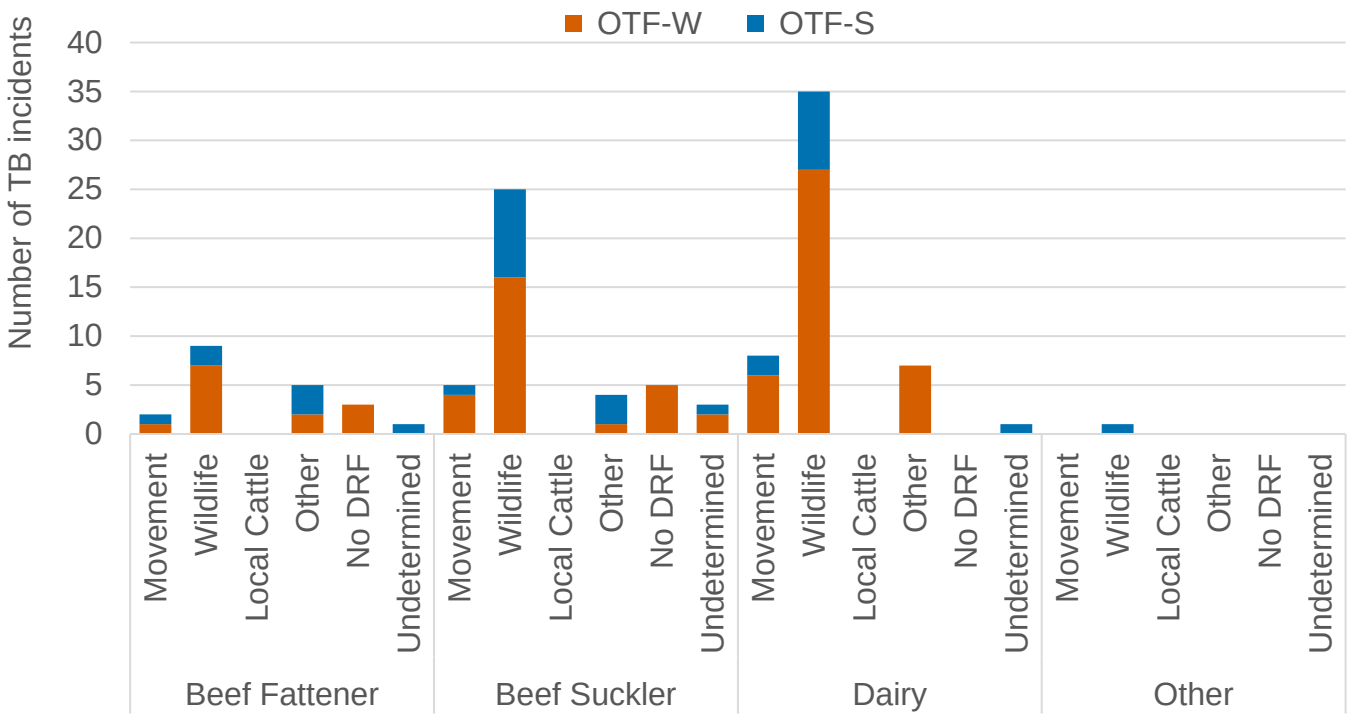


Figure 14: Source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in Derbyshire in 2019, by herd type. Note that the categories ‘movement’, ‘wildlife’, and ‘local cattle’ are comprised of incidents where these were the most likely single source of infection recorded. Incidents where the most likely single source was stated as ‘unknown’ were assigned to the category ‘undetermined’. ‘Other’ includes incidents where there was equal weighting between the most likely sources of infection as well as other pathways not categorised elsewhere.

## TB in other species

There is no statutory routine TB surveillance of non-bovine species, apart from post mortem examination (PME) of suspected clinical cases reported to APHA and post mortem meat inspection of animals (e.g. sheep, goats, pigs) slaughtered for human consumption.

There were no laboratory confirmed isolations of *M. bovis* in any other animal species, including domestic non-bovine farm animals (camelids, goats, sheep, and pigs), pets and captive deer in Derbyshire in 2019.

## Detection of incidents

The majority of TB incidents (64 out of 114) were disclosed by routine whole herd testing (WHT), as shown in Figure 15. Routine surveillance testing comprises six-monthly WHT for all farms in the former HRA portion of Derbyshire and annual WHT in the original Edge Area.

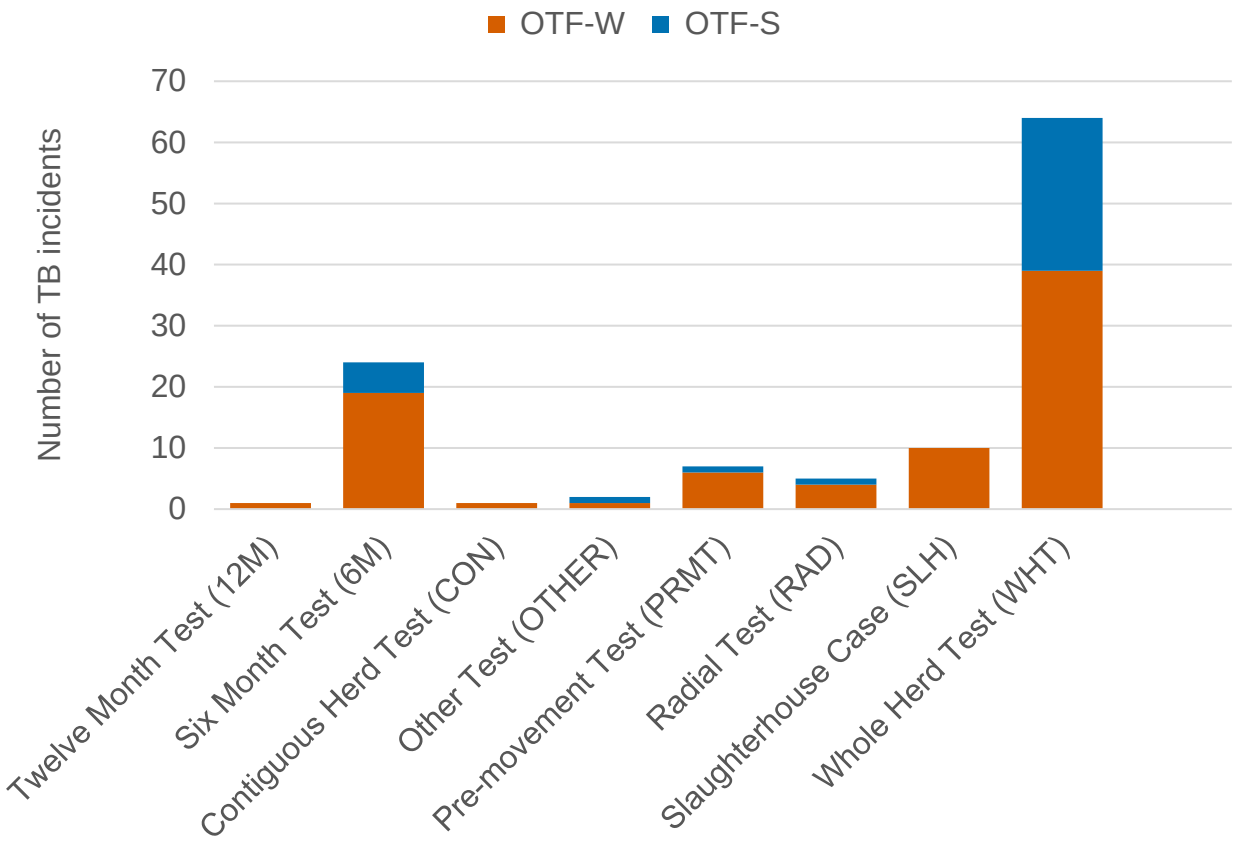


Figure 15: Number of TB incidents (OTF-W and OTF-S) in Derbyshire in 2019, disclosed by different surveillance methods.

The second most frequent type of test disclosing TB reactors was the six month check test (6M) carried out six months after conclusion of an incident. In 2019, 21% of incidents were disclosed at 6M testing compared to 11% in 2018.

Incidents recurring at 6M tests could be the result of a number of factors. It might be that disease was not completely removed from the herd by the incident testing programme (residual infection) and/or the source of infection still persists within the farm environment particularly where TB is endemic and there is suspected wildlife involvement.

In addition, incomplete cleansing and disinfection of premises following the end of incidents, as well as inadequate manure and slurry management and/or non-biosecure machinery and equipment sharing among farms can also lead to reinfection.

A further seven incidents in 2019 were disclosed through pre-movement testing (PRMT) and five more through radial testing (RAD) which emphasises the importance of additional targeted surveillance testing.

Post mortem meat inspection of OTF cattle at slaughterhouses (SLH) disclosed ten incidents in 2019 similarly to 2018 (11).

The number of incidents (OTF-S and OTF-W) that suffered an incident in the previous three years is shown in Figure 16. Almost half (40) of all new OTF-W incidents disclosed in 2019 had a history of TB infection in the previous three years. It is even more evident from this graph that recurrence of TB for reasons that have already been explained above appears to be a relatively common problem in Derbyshire.

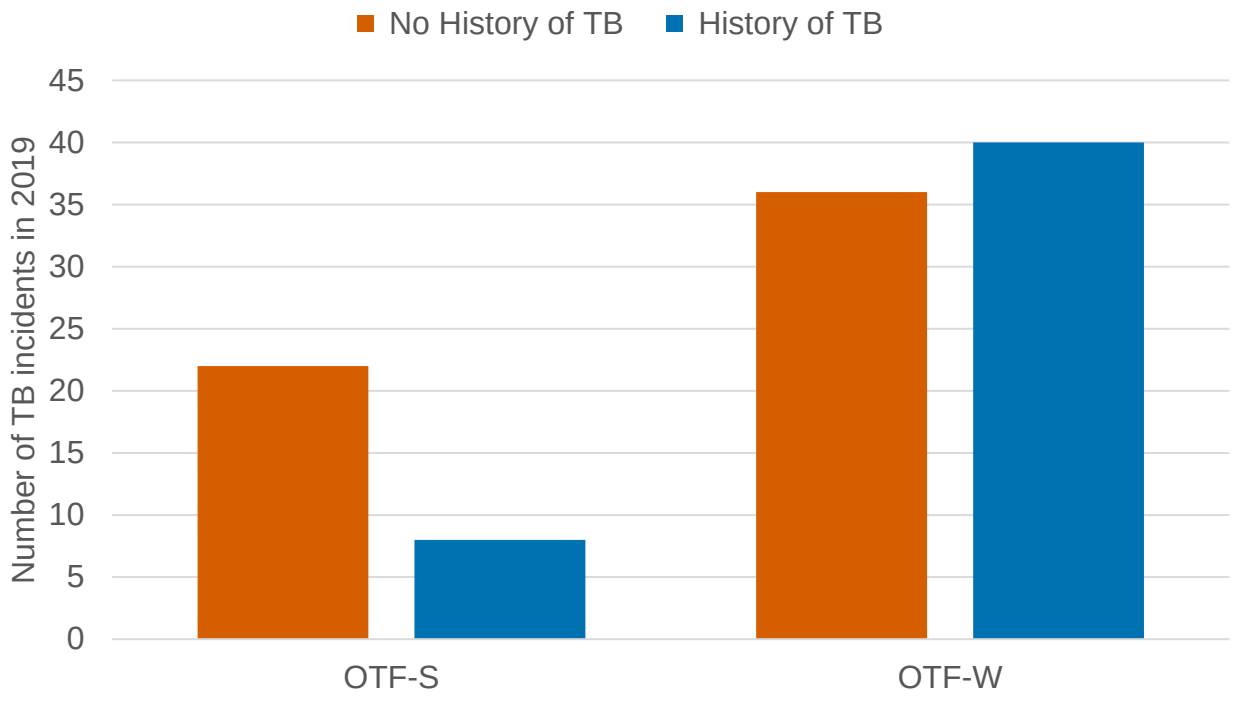


Figure 16: Number of TB incidents (OTF-W and OTF-S) in Derbyshire in 2019 on holdings that have suffered an OTF-W incident in the previous three years, and holdings with no history of TB in the previous three years.

## Skin test reactors and interferon gamma test positive animals removed

The number of reactors removed for TB control purposes can be used as a proxy measure of the burden of TB. Figure 17 shows the number of skin test reactors and IFN-γ test positive animals detected in Derbyshire from 2010 to 2019.

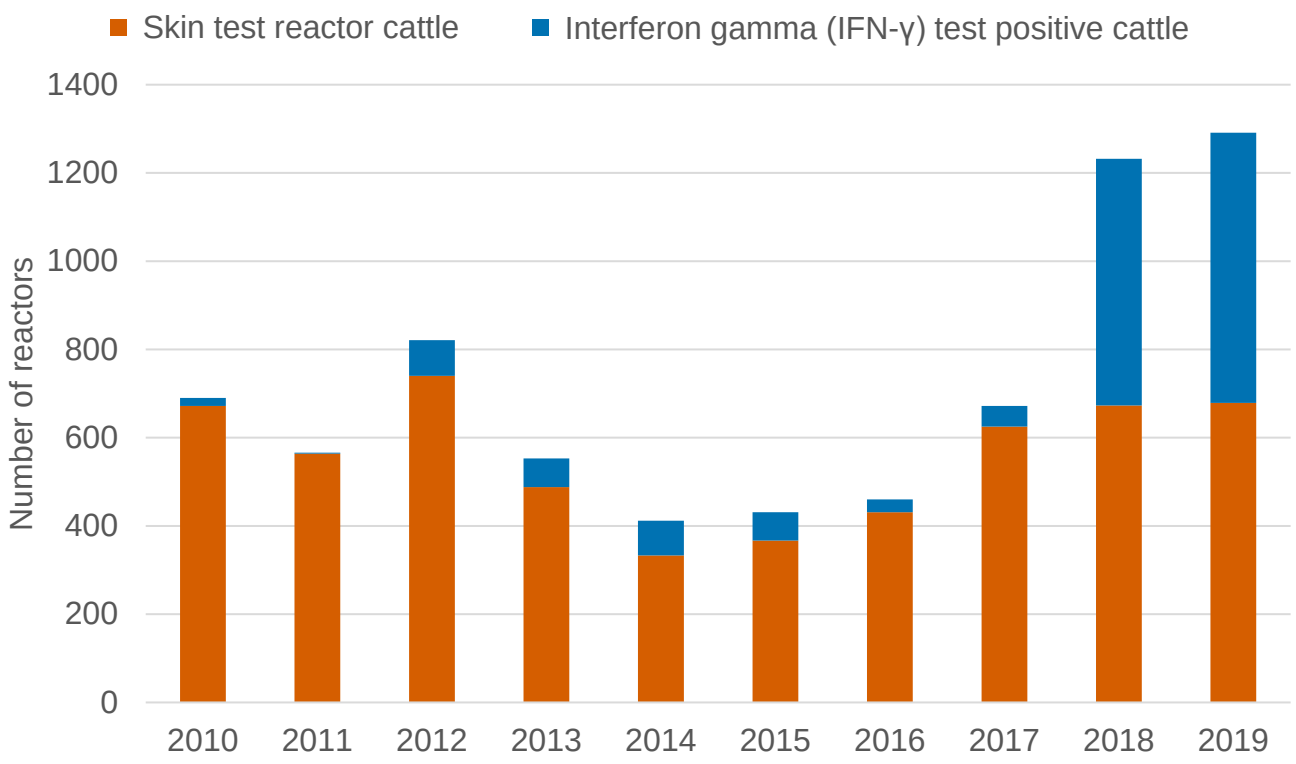


Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Derbyshire, 2010 to 2019.

A clear rise in numbers of reactors removed has occurred since 2015 with numbers of IFN-γ test positive animals almost doubling in 2018. This is due to the extension of the Derbyshire Edge Area to include the former HRA portion of the county and the subsequent increase in use of compulsory IFN-γ testing in OTF-W incidents.

This reporting year, a total of 1,291 cattle were slaughtered in Derbyshire of which 679 (53%) were skin test reactors and 612 (47%) were IFN-γ test positives which is not a marked increase when compared to the 1,232 cattle removed in 2018. However, on an individual incident level, the average number of reactors removed per incident has increased from 8.7 in 2018 to 11.3 in 2019. In view of the fact that the total number of new incidents decreased from 142 in 2018 to 114 in 2019 and the total number of cattle tested in 2019 (327,749) has also decreased since 2018 (345,615), the increase in reactors removed in 2019 is a result of longer incident duration, more reactors per incident and possibly larger herds affected. Altogether, the above numbers distinctly display that TB in Derbyshire continues to be significant and an increasing financial burden for both farmers and taxpayers.

# Summary of risks to Derbyshire

The summary of risks to Derbyshire remains unchanged from 2018, namely the risk of an advancing endemic front of infection from the neighbouring HRA county of Staffordshire along with the risk posed by longer distance cattle movements from other high risk areas of the country.

# Summary of risks from Derbyshire to surrounding areas

North Derbyshire continues to pose a potential risk to the adjacent LRA county of South Yorkshire which has a high cattle density with many large dairy herds. However, the lack of suitable badger habitat combined with enhanced surveillance testing of cattle (radial testing) around OTF-W incidents provides some mitigation against wildlife spread.

The occurrence of wildlife-linked incidents in areas close to the LRA of Greater Manchester appears to have declined somewhat in recent years compared to the peak in 2015. However, the potential of this corridor to act as a disease transmission route from endemic areas towards the LRA of Greater Manchester cannot be underestimated.

# Assessment of effectiveness of controls and forward look

The incorporation of the former Derbyshire HRA into the Edge Area in 2018 has resulted in a higher number of herd incidents in that area due to the increased frequency of surveillance testing, which also highlights that the increase in sensitivity of testing succeeding in identifying and removing infected cattle more rapidly. However, there is indirect epidemiological evidence of infected wildlife in this area and so control of infection in both cattle and badger populations is required to achieve a healthier population of both.

In cattle, the mandatory use of IFN-γ testing alongside skin testing in herds with OTF-W incidents is detecting infected cattle undisclosed by initial skin testing, which means that they are removed from the herd as soon as possible. However, this needs to be complemented by reducing or removing the main infection pathways in order to keep these herds free from disease. Application of appropriate badger control measures will be necessary to support these enhanced cattle measures and enable removal of as much infection as possible. The Badger Edge Vaccination Scheme (BEVS) is ongoing in areas of Derbyshire and may support the buffering of areas of low disease incidence from advancing endemicity.

Biosecurity awareness is increasing amongst the farming community through different routes such as communications with APHA case vets, the farmers' own veterinary providers, the implementation of

the TB Advisory Service (TBAS, www.tbas.org.uk/), and access to the TB Hub website (www.tbhub.co.uk). Anecdotally, farmers' understanding of different aspects of the ecology of the disease is improving as a result and this is helping them to recognise and implement appropriate biosecurity measures. The awareness of the importance of informed cattle purchasing is also increasing aided by the availability and use of the interactive mapping tool, ibTB (www.ibtb.co.uk).

# Appendices

## Appendix 1: overview of risk and surveillance areas of England and Edge Area objectives and controls

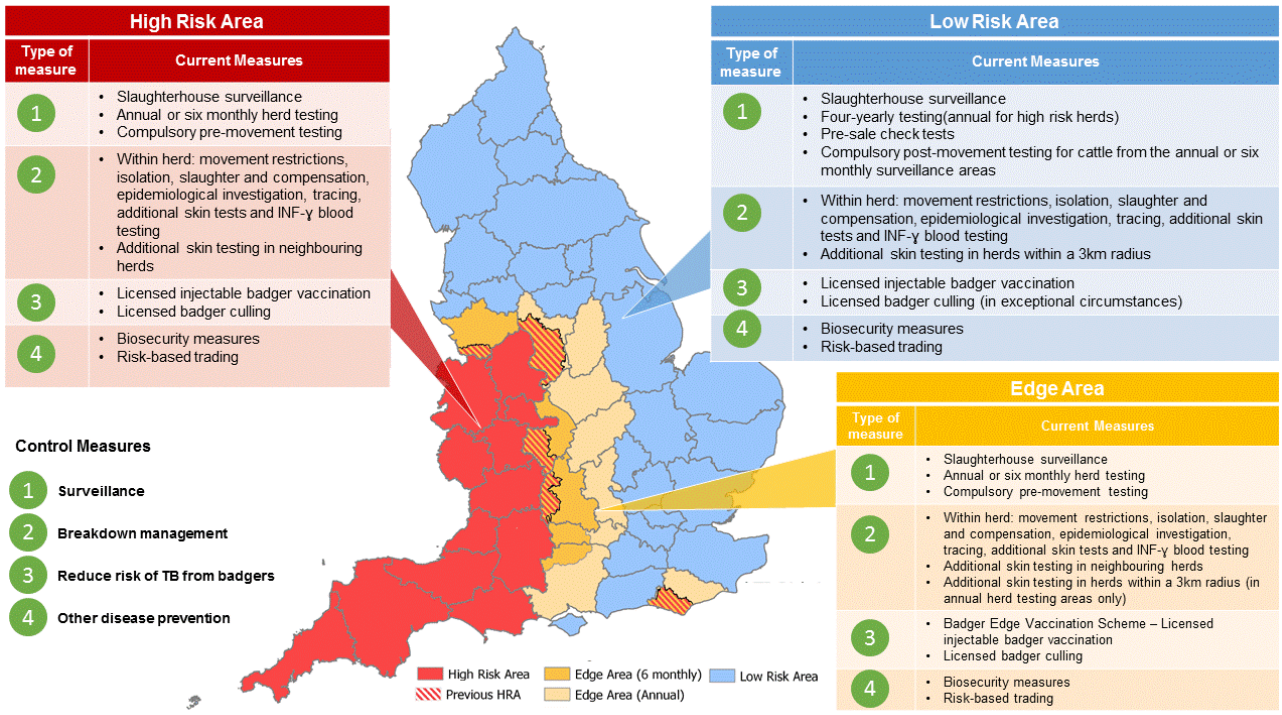


Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Bovine Tuberculosis Free status for England. Map based on information published on www.tbhub.co.uk.

### Policy objectives for the Edge Area

Short to medium term:

- slow down geographic spread
- maintain crude herd incidence of OTF-W incidents <2% overall by 2019
- begin to reduce the incidence rate

Longer term:

- reduce geographic spread of TB and push the Edge Area boundaries westward
- reduce OTF-W herd incidence to <1% by 2025
- attain OTF status (crude incidence of indigenous OTF-W herd incidents <0.1%) for the lowest incidence counties in the Edge Area

For more information about the governments approach to controlling TB, visit the 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

Surveillance:

- six monthly or annual routine herd testing
- additional targeted surveillance of cattle herds located within a 3km radius of new OTF-W incidents in annual testing sections of the Edge Area (radial testing)
- slaughterhouse (SLH) surveillance

Management of cases ('incidents'):

- increased sensitivity of incident herd testing:
- all incident herds must pass two consecutive short interval skin tests at severe interpretation to regain OTF status, irrespective of PM and bacteriological findings
- mandatory IFN-γ parallel testing of herds with OTF-W incidents
- enhanced management of herds with persistent incidents
- enhanced epidemiological investigation and data analysis
- information sharing - location of incident herds publicly available (using ibTB online (www.ibtb.co.uk) interactive mapping tool)
- restriction for life of all inconclusive reactors (IRs) that give a negative result on a re-test was introduced in November 2017. The only permitted movements of these animals are to slaughter or an Approved Finishing Unit

TB controls in the wildlife reservoir (badgers):

- licensed badger culling in high incidence sections of the Edge Area
- Government grants for licensed voluntary badger vaccination projects using injectable badger BCG (Badger Edge Vaccination Scheme - BEVS)

Other measures:

- compulsory pre-movement skin testing of cattle moved between herds
- promotion of herd biosecurity measures to reduce the risk of new incidents

## Summary of enhanced TB control measures in Derbyshire

Edge Area testing policy:
From January 2018, six-monthly herd surveillance testing replaced annual herd surveillance testing in the former HRA portion of Derbyshire. Since May 2019, some cattle herds in these parts of Derbyshire are eligible for annual surveillance testing if they meet either of the following criteria:

- the herd has been in existence for at least six years and has not had a TB incident in that six year period. A single break from keeping cattle of less than four months during the six year period is permitted
- the herd is registered to a bovine TB health scheme accredited under the Cattle Health Certification Standards (CHeCS) at level 1 or above

Radial testing of herds in a 3km radius around an OTF-W incident holding continues in the original Edge Area portion of Derbyshire, along with annual surveillance testing.

Mandatory IFN-γ testing continues to apply in all new OTF-W incidents in Derbyshire. Exemptions are applied where there is clear epidemiological separation of certain groups of cattle within the herd after the initial round of testing thus making it more targeted and cost-effective.

Other testing measures:
Discretionary exemptions from annual routine surveillance whole herd testing were approved for beef finishing units if they met the following strict set of criteria:

- All cattle move directly to the abattoir
- No cattle to be resident on the holding for more than 12 months
- No births in the unit
- No breeding activity in the unit
- All cattle must be permanently housed or yarded (no grazing)
- Holdings are required to reapply for an exemption on an annual basis in order to ensure regular review of compliance

Occasionally testing becomes overdue but is usually resolved within 60 days of the test becoming overdue. There is no evidence that delayed tests had any notable impact on the epidemiology of TB in Derbyshire in 2019.

Other control measures:
The TB Advisory Service is providing farmers with free bespoke biosecurity advice.

Official Veterinarian (OV) TB skin testing quality assurance audits continue to be carried out by APHA in parallel with those being completed by the Veterinary Delivery Partners who are contracted to provide TB skin testing on behalf of APHA. Local Authority liaison is maintained as necessary, especially regarding the enforcement of overdue TB tests, illegal movements of animals whilst under TB restrictions, and the fraudulent manufacturing of skin test reactors.

# Appendix 2: cattle industry in Derbyshire

Table A2.1: Number of cattle premises by size band in Derbyshire 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** | 6 | 774 | 256 | 273 | 129 | 68 | 46 | 1552 | 107 | 50 |

*The number of herds with an undetermined size.

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

| Breed purpose | Beef | Dairy | Dual purpose | Unknown | Total |
|---|---|---|---|---|---|
| **Number of Cattle** | 91,287 (54%) | 68,047 (40%) | 6842 (4%) | 4 (<0.01%) | 166,180 |

# Appendix 3: summary of headline cattle TB statistics

Table A3.1: Herd-level summary statistics for TB in cattle in Derbyshire between 2017 and 2019.

| Herd-level statistics | 2017 | 2018 | 2019 |
|---|---|---|---|
| (a) Total number of cattle herds live on Sam at the end of the reporting period | 1785 | 1736 | 1740 |
| (b) Total number of whole herd skin tests carried out at any time in the period | 1829 | 2446 | 2363 |
| (c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason | 1480 | 1486 | 1445 |
| (d) Total number of OTF cattle herds at the end of the report period (i.e. herds not under any type of Notice Prohibiting the Movement of Bovine Animals (TB02) restrictions) | 1683 | 1564 | 1609 |
| (e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period | 1712 | 1637 | 1655 |
| (f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs) | 112 | 142 | 114 |
| • OTF-S | 37 | 58 | 33 |
| • OTF-W | 75 | 84 | 81 |
| (g) Of the OTF-W herd incidents: | | | |
| • How many can be considered the result of movement, purchase or contact from/with an existing incident based on current evidence? | 4 | 20 | 11 |
| • New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests | 0 | 49 | 39 |

| Herd-level statistics | 2017 | 2018 | 2019 |
|---|---|---|---|
| • New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.) | 1 | 5 | 32 |
| • New OTF-W incidents first detected through routine slaughterhouse TB surveillance | 12 | 11 | 10 |
| (h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds | | | |
| • OTF-S | 1 | 1 | 2 |
| • OTF-W | 4 | 2 | 0 |
| (i) 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, but not including non-grazing Approved Finishing Units) | 52 | 67 | 64 |
| (j) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved) | 0 | 0 | 0 |
| (k) Number and type of finishing units active at end of the period: | | | |
| • Approved Finishing Units: Grazing | 0 | 0 | 0 |
| • Approved Finishing Units: Non Grazing | 7 | 10 | 12 |
| • Exempt Finishing Units: Grazing | 2 | 2 | 2 |
| • Exempt Finishing Units: Non Grazing | 5 | 4 | 4 |

Table A3.2: Animal-level summary statistics for TB in cattle between 2017 and 2019.

| Animal-level statistics (cattle) | 2017 | 2018 | 2019 |
|---|---|---|---|
| (a) Total number of cattle tested in the period (animal tests) | 250,005 | 345,615 | 327,749 |
| (b) Reactors detected in tests during the year: | | | |
| • Tuberculin skin test | 625 | 673 | 679 |
| • Additional IFN-γ blood test reactors (skin-test negative or IR animals) | 47 | 559 | 612 |
| (c) Reactors detected during year per incidents disclosed during year * | 6.0 | 8.7 | 11.3 |
| (d) Reactors per 1000 animal tests | 2.7 | 3.6 | 3.9 |
| (e) Additional animals slaughtered during the year for TB control reasons: | | | |
| • DCs, including any first-time IRs | 11 | 33 | 12 |
| • Private slaughters | 2 | 12 | 12 |
| (f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA) | 30 | 15 | 25 |
| (g) SLH cases confirmed by culture of *M. bovis* ** | 18 | 12 | 11 |

* 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 Derbyshire, in 2019.

| Source of infection | Possible (1) | Likely (4) | Most likely (6) | Definite (8) | Weighted contribution |
|---|---|---|---|---|---|
| Badgers | 31 | 49 | 55 | 1 | 61.4% |
| Cattle movements | 14 | 10 | 8 | 5 | 16.7% |
| Contiguous | 14 | 5 | 0 | 0 | 3.3% |
| Residual infection | 14 | 11 | 7 | 0 | 10.3% |
| Domestic animals | 0 | 0 | 0 | 0 | 0.0% |
| Non-specific reactor | 0 | 0 | 0 | 0 | 0.0% |
| Fomites | 4 | 0 | 0 | 0 | 0.5% |
| Other wildlife | 17 | 1 | 0 | 0 | 2.4% |
| Other or unknown source | 1 | 0 | 0 | 0 | 5.5% |

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 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

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