Animal & Plant Health Agency

Year-end descriptive epidemiology report: Bovine TB in the Edge Area of England

County: Derbyshire

Year-end report for: 2020

TR398 (Rev. 03/21)

Contents

Executive summary

Reporting area

Derbyshire is part of the Edge Area that was established in 2013. In 2014, the bovine tuberculosis (TB) surveillance strategy for this area was incorporated into the UK government's strategy to achieve Officially Bovine Tuberculosis Free (OTF) status for England by 2038. 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 13 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 TB incidents

The number of new TB incidents in Derbyshire increased from 114 in 2019 to 147 in 2020. This increase was mainly seen in Officially Bovine Tuberculosis Free Status Suspended (OTF-S) incidents from 33 in 2019 to 69 in 2020, while the number of Officially Bovine Tuberculosis Free Status Withdrawn (OTF-W) incidents remained similar at 78 in 2020 compared to 81 in 2019.

Risk pathways for TB infection

Wildlife was considered to be the most likely source of infection for new incidents reported in Derbyshire in 2020, with badgers providing a weighted contribution of approximately 57% of all risk pathways. Movement of undetected infected cattle contributed to 18% of risk pathways and is the second main source of infection for TB 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 to the 2020 bovine TB epidemiology reports.

Disclosing tests

The majority of TB incidents (96% of total) were disclosed by active on-farm surveillance testing whilst slaughterhouse surveillance (post-mortem meat inspection) detected six new incidents in 2020.

Reactor numbers

In total, 1,225 cattle were compulsorily slaughtered for TB control in Derbyshire in 2020. Of these, 691 were skin test reactors and 534 were detected by interferon gamma (IFN-γ) testing.

Altogether, there was a slight decrease in the number of animals removed for TB control compared to 2019 (1,291) and mainly due to IFN-γ test positive animals (612 in 2019), while the number of skin test reactors did not change significantly (679 in 2019).

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 may reduce the risk to Derbyshire but continued spread of infected wildlife from the HRA is also a risk.

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
- continuation and further adoption of measures to prevent the spread of TB from wildlife, including biosecurity and badger control

Introduction

This report describes the level of bovine tuberculosis in cattle herds in Derbyshire in 2020. Bovine tuberculosis is caused by the organism *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 this area, 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. 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

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.

Since May 2019, cattle herds in the six-monthly parts of the Edge Area that meet certain criteria are eligible to return to 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.

Changes due to COVID-19

During 2020, public health measures adopted by the government to contain the COVID-19 outbreak impacted the ability to carry out some TB testing due to social distancing and self-isolation guidelines, affecting both veterinarians and farmers.

In particular, from 23 March 2020, routine or targeted TB skin tests were not mandatory for cattle under 180 days old where, in the official veterinarian's judgement, the young stock could not be tested safely in line with social distancing guidelines. The temporary amendment allowing calves under 180 days old to be excluded from TB testing did not apply to short interval tests in TB incident herds (required to restore a herds OTF status) or pre- and post-movement testing.

Routine TB skin tests are required within a pre-defined window of time to maintain a herd's OTF status. From 23 March 2020, for tests that were allocated until 30 June 2020, the Animal and Plant Health Agency (APHA) permitted an extension to the TB skin testing windows on a case by case basis, where testing had not been completed due to valid reasons associated with COVID-19.

The testing window for short interval tests was also extended by up to 30 days, where tests were unable to be completed due to COVID-19.

Furthermore, on-farm epidemiological assessments carried out to establish the route of infection for a TB incident herd were carried out remotely, by telephone, for the majority of 2020.

Cattle industry

Herd types

Beef suckler and fattening herds are the predominant herd type in Derbyshire, with 55% 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 to 1,000 cattle) with larger herds typically located in south and west Derbyshire. Only a small percentage of cattle in Derbyshire (3%) are sired by a dual-purpose bull, suitable for both beef and milk.

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.

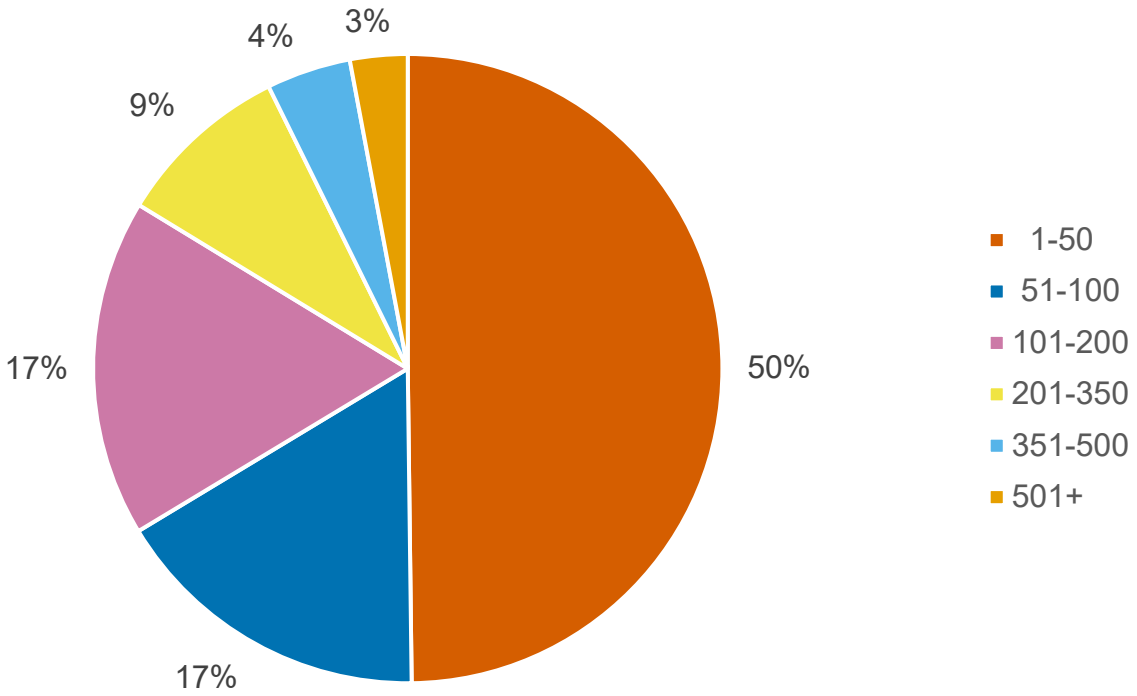


Figure 1: Proportion of cattle holdings in Derbyshire, by herd size in 2020 (n=1,522). Note: herds with an undetermined size are not shown.

Markets and abattoirs

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.

There is one approved cattle collection centre in Derbyshire which allows farmers to utilise a secure, safe and welfare friendly service to sell their livestock in an efficient and competitive manner.

No premises were licensed to hold an animal gathering for the purpose of show/exhibition in 2020 in Derbyshire due to the COVID-19 public health pandemic.

There are four abattoirs licensed to slaughter cattle in Derbyshire.

Approved Finishing Units

One additional Approved Finishing Unit (AFU) for TB-restricted cattle was approved in Derbyshire in 2020 giving a total of thirteen 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 2020 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 analytical measures are used to describe the level of TB infection in these reports.

1. The number of new herd incidents that were disclosed in each year (Figure 2).
2. The annual herd incidence rate, reported as the number of new incidents per 100 herd-years at risk (100 HYR) (Figure 3). 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 (Figure 4). 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 snapshot 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 (excluding Figure 5) 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 number of new infected herds per year over the last ten years in Derbyshire. In the whole county (Figure 2), the number of new incidents increased from 136 in 2011 to 153 in 2012, then decreased and stabilised between 2013 and 2017 (averaging 118 incidents per year during this time period).

In 2018, there was a sharp increase in the number of new incidents (142) followed by a decrease to 114 incidents in 2019. The number of new incidents increased again to 147 in 2020.

This change was mainly observed in the number of OTF-S incidents which dropped from 58 in 2018 to 33 in 2019 and rose again to 69 in 2020, while the number of OTF-W incidents remained similar over the past three years (84 in 2018, 81 in 2019 and 78 in 2020).

The fluctuation in the number of new incidents between 2018 and 2020 may be the result of the changes introduced to the Edge Area in January 2018. Following the reclassification of the whole county of Derbyshire as Edge Area, the frequency of routine surveillance testing increased from annual to six monthly in the former HRA portion of the county which most likely led to earlier identification of previously undisclosed disease in some of the herds.

Additionally, earned recognition was introduced in 2019 where lower risk cattle herds reverted to annual surveillance testing reducing the number of tests in these herds to once a year. This may partly explain the significant increase in the number of new incidents detected in 2018 and the subsequent reduction during 2019.

The following increase observed in 2020 may be an indication that appropriate badger control measures are needed to support these enhanced cattle measures and see some continuity on the reduced disease incidence in cattle over time in this county.

The start of licenced badger culling in one control area of Derbyshire in 2020 resulted in 2,916 badgers removed.

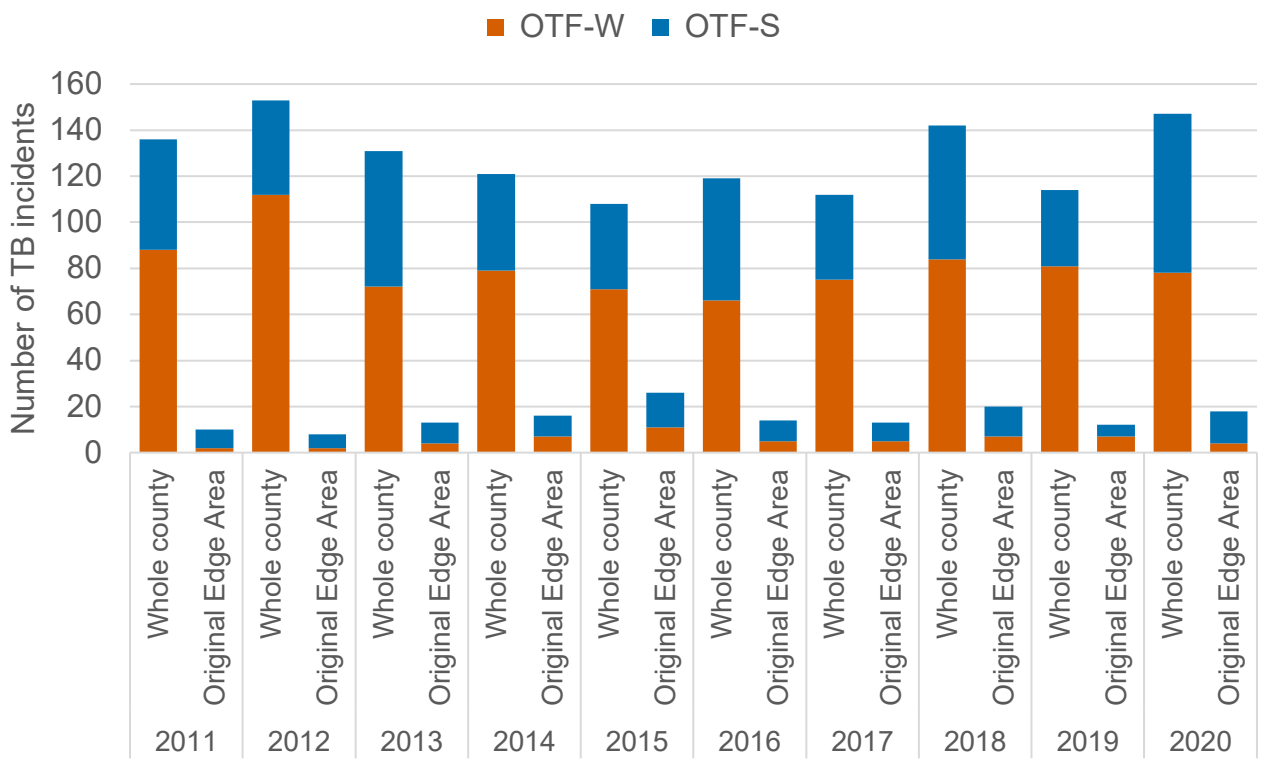


Figure 2: Annual number of new TB incidents in Derbyshire, from 2011 to 2020, showing incidents for the whole county and the original Edge Area.

The majority of new cattle incidents in Derbyshire in 2020 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 incidents) 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.

The annual herd incidence rate per 100 herd-years at risk (Figure 3) is calculated as the number of new herd incidents detected during the reporting period, divided by the total time that herds under surveillance during that period were at risk of infection. The time at risk calculation takes the different testing frequencies into account and provides a measure that is comparable over time.

The annual herd incidence rate in the whole of Derbyshire has seen a steady increase over the past three years (10.6 in 2020 compared to 9.3 in 2019 and 8.2 in 2018), while it continued to fluctuate in the original Edge Area of Derbyshire (4.4 in 2020, 3.3 in 2019 and 5.0 in 2018).

A detailed description of the methodology used to calculate incidence is available in the Explanatory Supplement for 2020.

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 (Figure 4). 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.

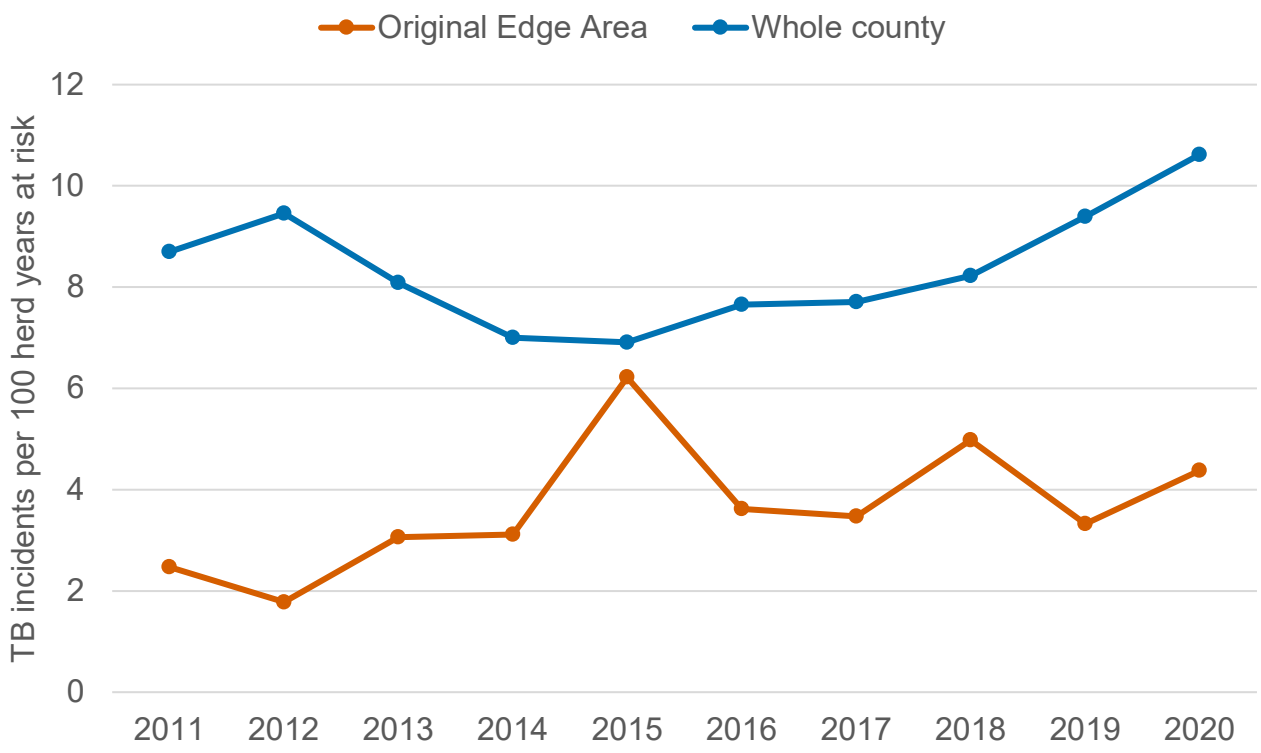


Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Derbyshire, from 2011 to 2020, showing incidents for the whole county and the original Edge Area.

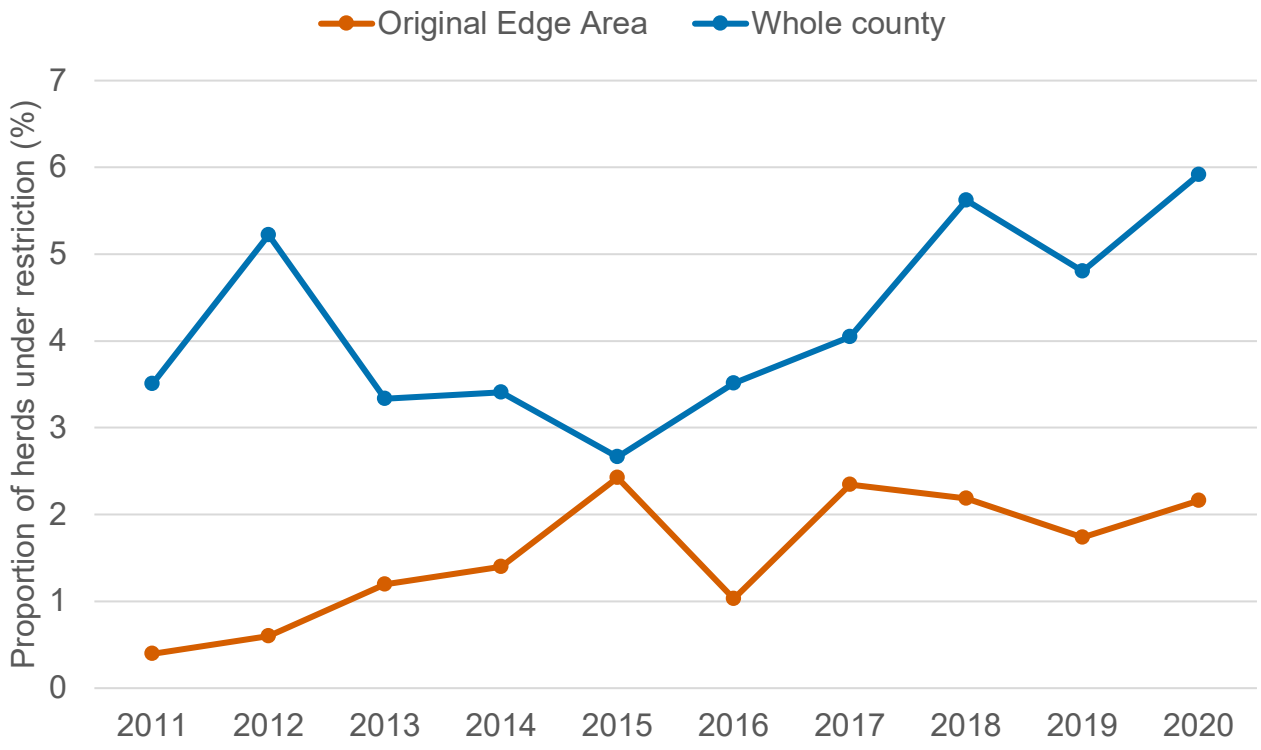


Figure 4: Annual end of year prevalence in Derbyshire, from 2011 to 2020, showing incidents for the whole county and the original Edge Area.

Similarly, to herd incidence, a fluctuating pattern is also observed in the herd prevalence over the past ten years in Derbyshire (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. 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% and rose once more to 5.92% in 2020.

The 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 the presence of residual infection in some herds and reinfection from wildlife sources is often the cause of prolonged incidents and makes it difficult to resolve herd infections.

The decrease in herd prevalence observed in 2019 may have occurred as a result of the increased testing frequency and use of mandatory IFN-γ testing to all new OTF-W incidents which lead to a shortening of the duration of incidents. Despite the expectation that these measures would have kept a reducing trend in herd prevalence in Derbyshire, 2020 saw the highest herd prevalence recorded since 2011.

The impact of the COVID-19 pandemic on TB testing during 2020 may have partly contributed to the increase in herd prevalence. In particular, extensions of the TB testing window where tests were unable to be completed due to COVID-19 related disruptions may have had a direct effect on prevalence by lengthening the duration of TB incidents.

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 2020 whole county herd incidence rate (incidents per 100 herd-years at risk) in Derbyshire was 10.6 (Figure 5). This is slightly above the Edge Area average of 10.1, and below the average herd incidence in the HRA (16.2). 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.

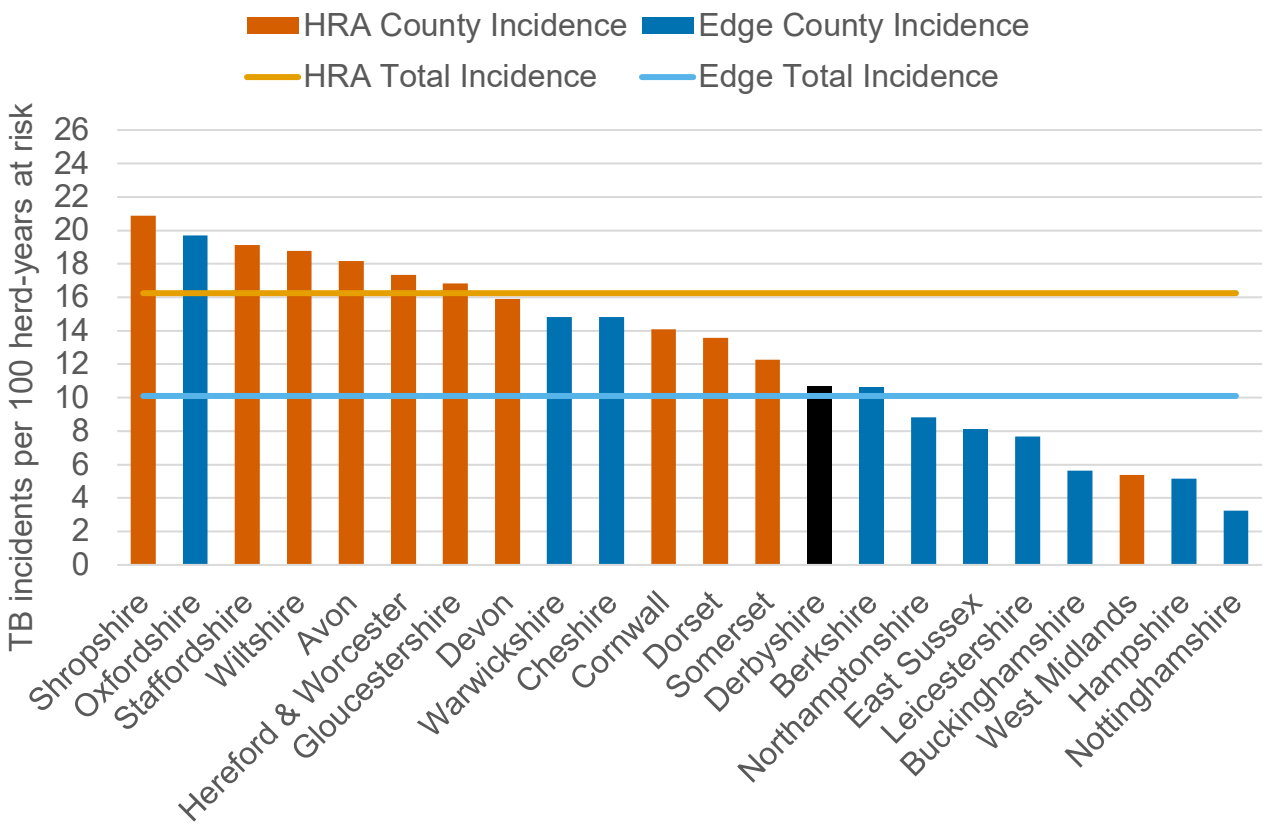


Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S including finishing units) in 2020, by HRA and Edge Area County, highlighting the county of Derbyshire.

The geographical distribution of existing and new TB incidents in 2020 and their associated spoligotype of *M. bovis* is shown in Figure 6. Similar to 2019, 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.

New incidents continue to increasingly occur further east towards central Derbyshire in 2020 as in 2019 and new dispersed OTF-S incidents continue to occur in north Derbyshire, bordering the LRA counties of South Yorkshire, West Yorkshire, and Greater Manchester.

The geographic distribution throughout Derbyshire of TB incidents with likely wildlife involvement (Figure 7) shows that, as observed in 2019, incidents cluster 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.

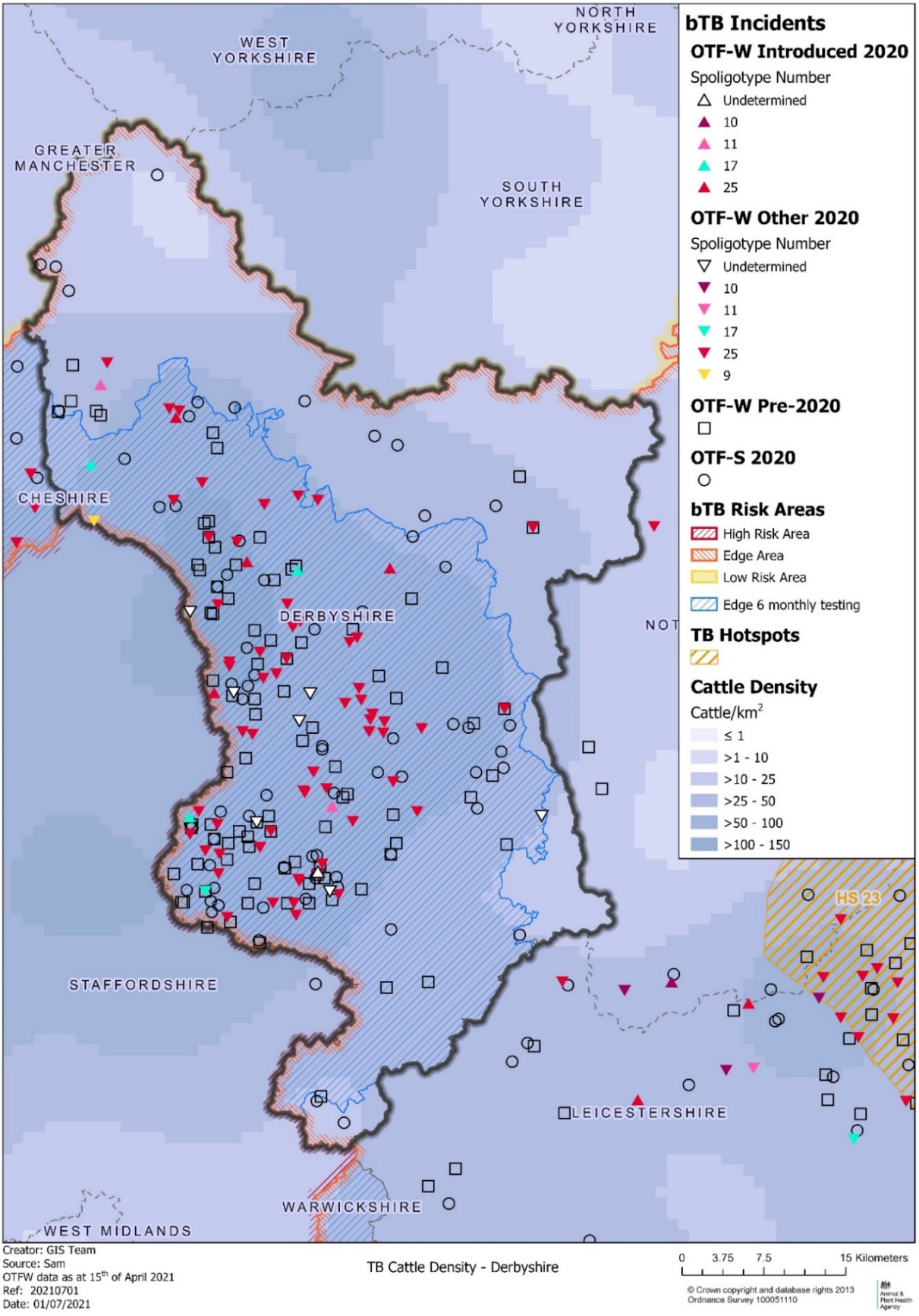


Figure 6: Location of cattle holdings in Derbyshire with new TB incidents (OTF-W and OTF-S) in 2020 and cattle holdings with pre-2020 OTF-W incidents still ongoing at the beginning of 2020, overlaid on a cattle density map. Note 'OTF-W Introduced 2020' refers to OTF-W incidents in which cattle movements were the most likely source of infection.

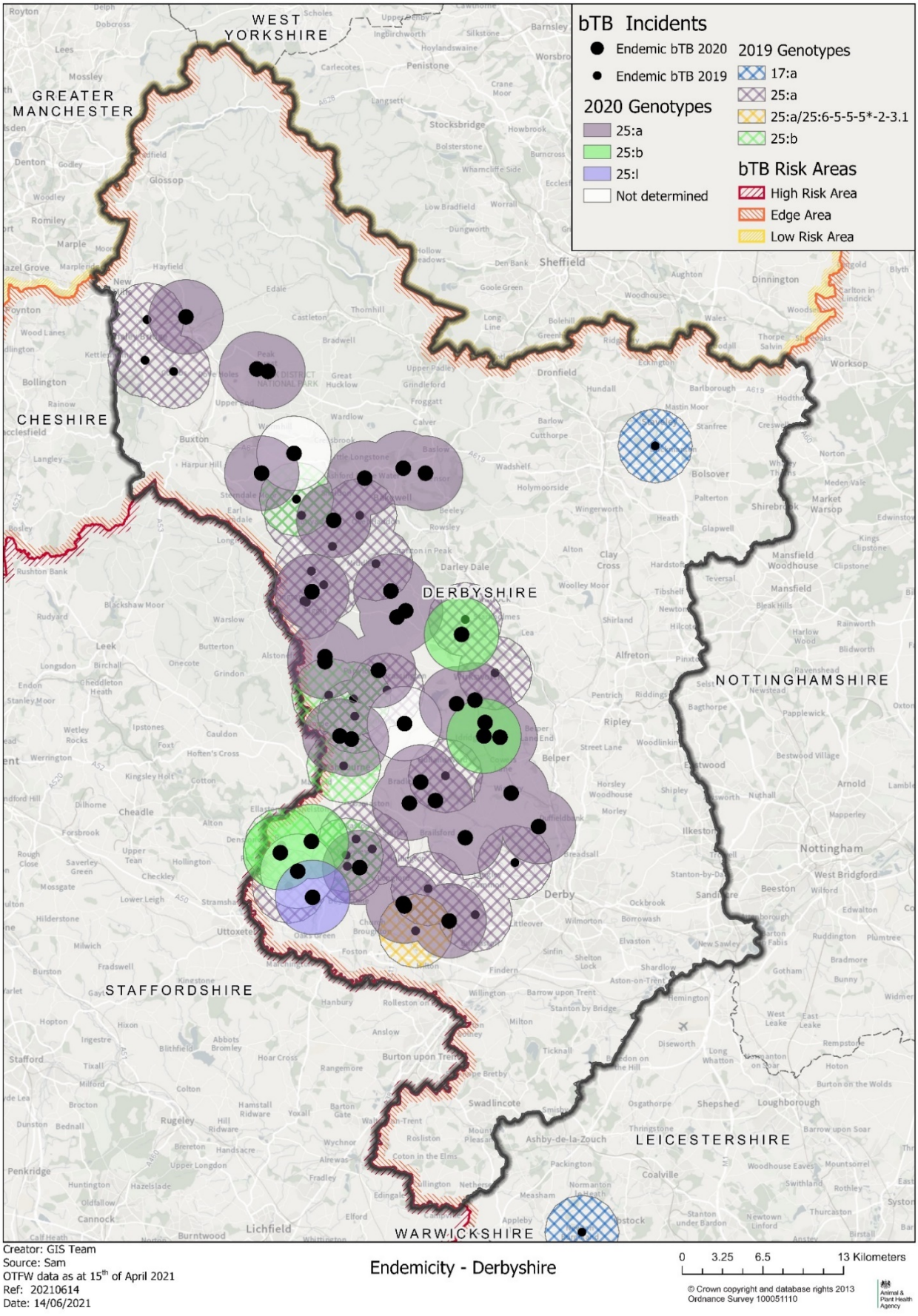


Figure 7: Genotypes of *M. bovis* detected in Derbyshire between 2019 and 2020, where wildlife sources were attributed with a 75% certainty or above according to the DRF calculation, as an indication of local *M. bovis* reservoir in wildlife populations (OTF-W incidents only).

Other characteristics of TB incidents

Incidents by herd type

Similarly, to 2019, 47% of all TB incidents in 2020 occurred in dairy herds (69 out of 147, Figure 8). Beef suckler herds accounted for 31% of incidents (45) followed by beef fatteners which represented only 21% of incidents (31).

The largest number of incidents (37) occurred in the 101 to 200 herd size group, which represents 17% of all herds followed by 31 incidents in the 201 to 350 herd size group, which represents 9% of all herds. Larger herds represent only a small percentage of all herds and for this reason disclose a lower but still significant number of incidents in proportion (for example, 14 incidents occurred in the 501 plus herd size group which represents 3% of all herds).

This contrasts with the 29 incidents disclosed in small herds of up to 50 cattle which represent 50% of all herds in Derbyshire.

This is in line with the 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).

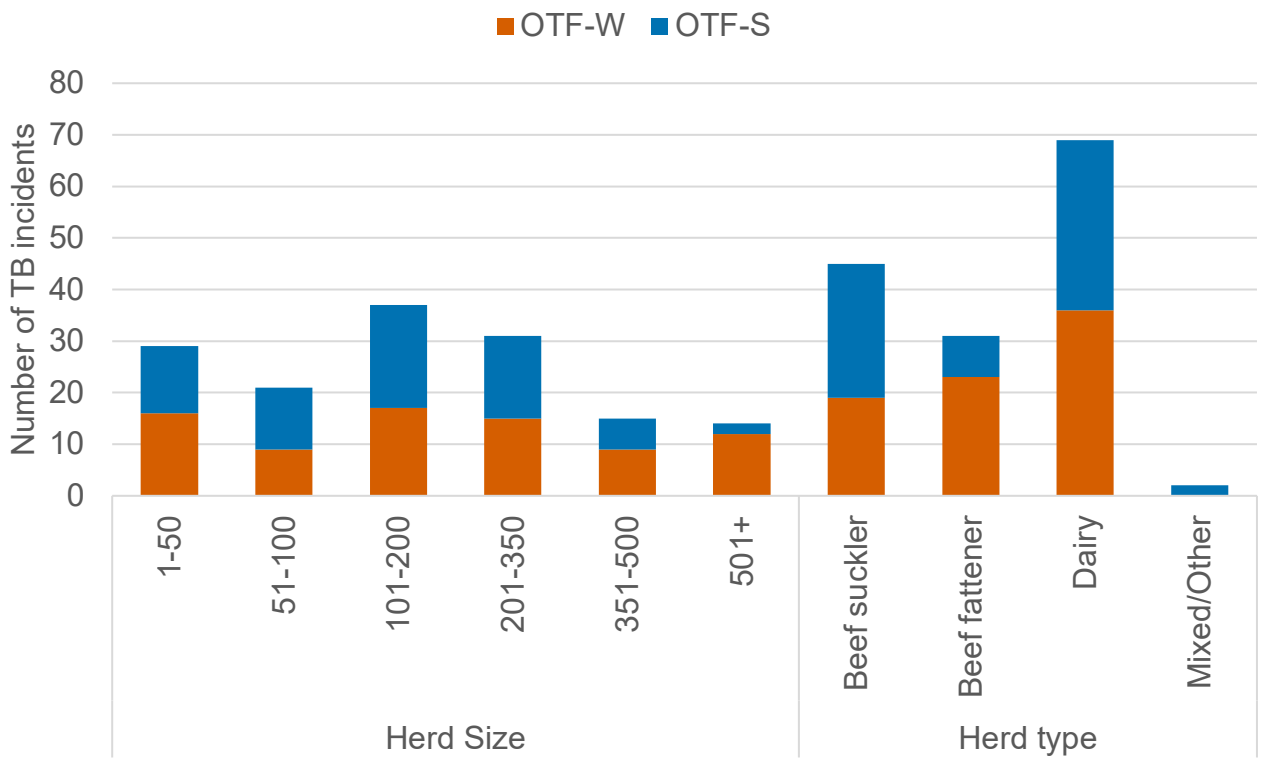


Figure 8: Number of TB incidents (OTF-W and OTF-S) in Derbyshire in 2020, by cattle herd size and type.

Incidents by month of disclosure

The numbers of incidents disclosed in Derbyshire by month, from January to December 2020 is shown in Figure 9.

There were high rates of disclosure from October to December with an average of 18 incidents disclosed each month followed by a peak in May with 17 incidents disclosed.

The observed trend in the numbers of incidents disclosed by month is relatively consistent with the actual number of tests undertaken over the year (Figure 10).

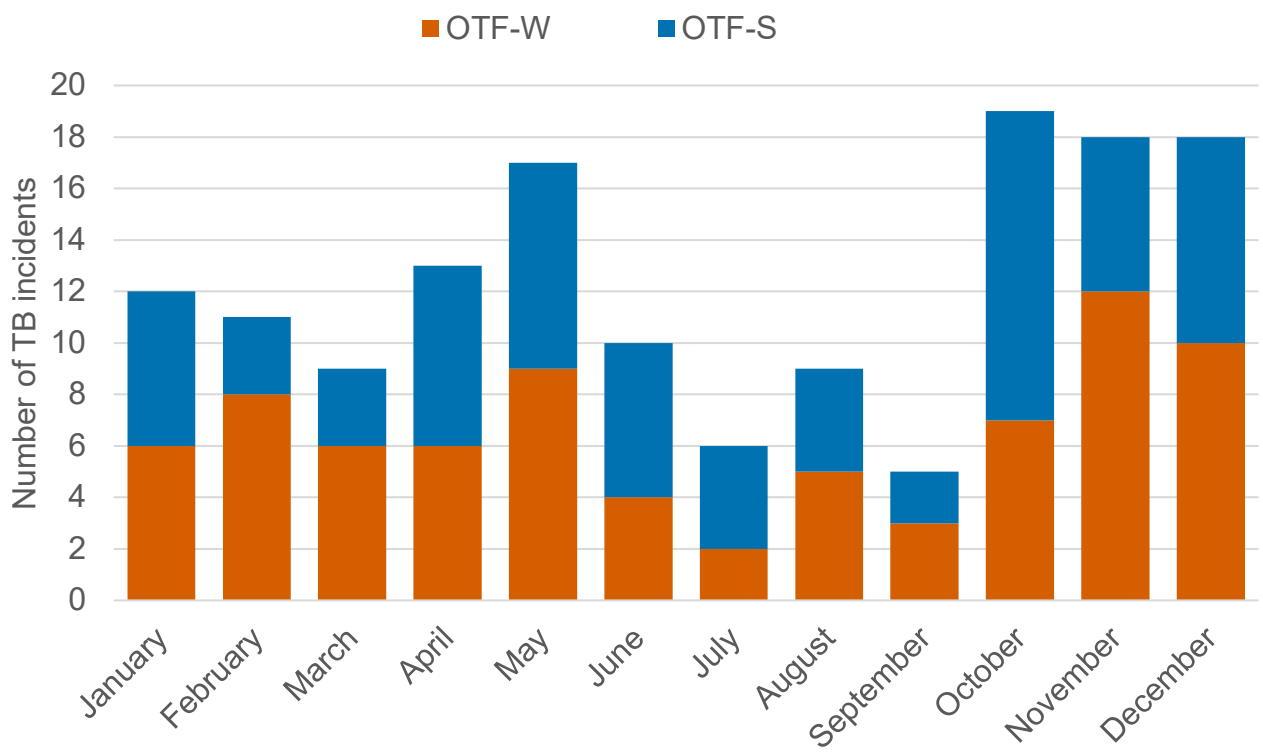


Figure 9: Number of TB incidents (OTF-W and OTF-S) in Derbyshire in 2020, by month of disclosure.

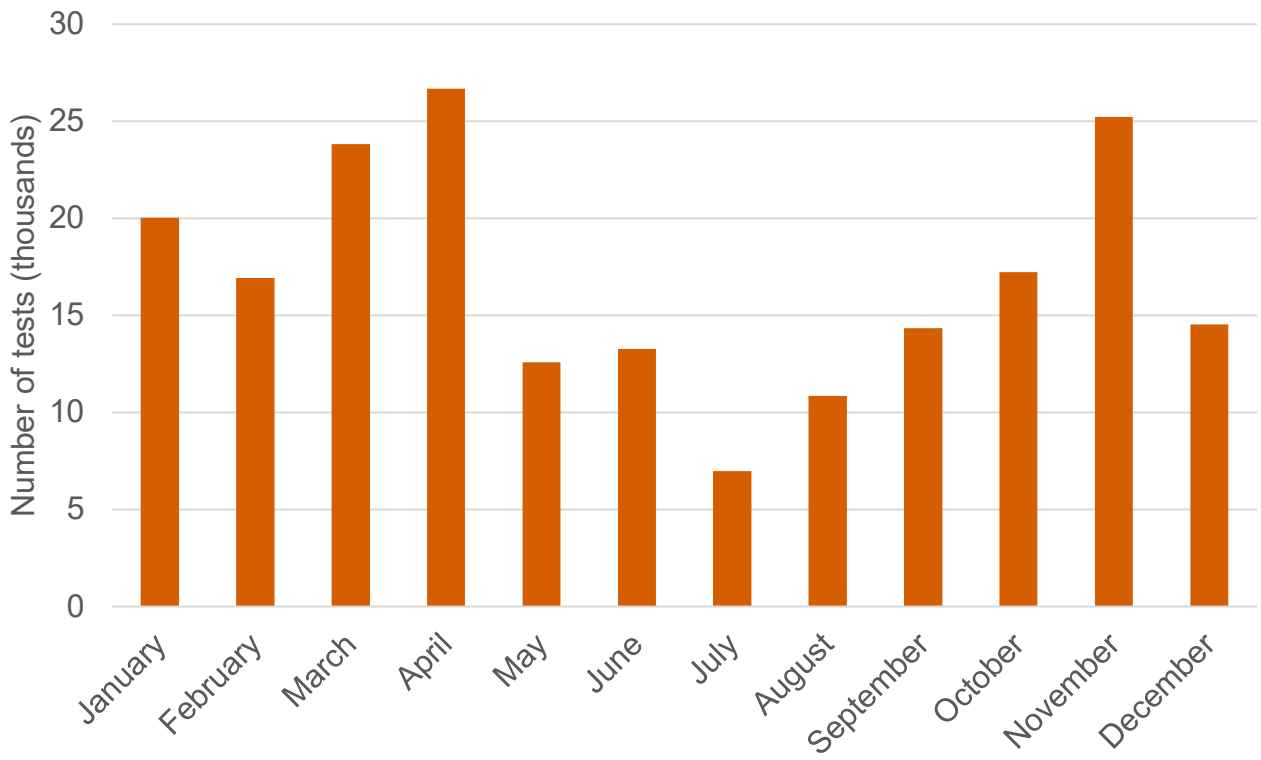


Figure 10: Number of tests undertaken in OTF herds in Derbyshire in 2020, by month.

Peak testing in 2020 occurred in spring (March to April) and in November, reflecting farmers preference to test before cattle are turned out to pasture and/or at the start of winter housing. New incidents may be more likely to be disclosed during these months simply because more tests are conducted.

However, the peak of number of incidents observed in May and December did not correlate with the number of tests carried out in these months so there are likely to be other factors involved.

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 and may be contributing to earlier detection of disease.

Duration of incidents

As per previous years, the majority (53%) of all TB incidents resolved in 2020 (including incidents that were carried over from previous years) had a duration of 151 to 240 days (Figure 11).

For the 80 OTF-W incidents which closed in 2020, the average duration was 274 days: similar to 2019 (269). The median OTF-W duration was 236 days also similar to 2019 (241).

The 45 OTF-S incidents which closed in 2020 had an average duration of 182 days (197 in 2019) and a median of 160 days (183 in 2019).

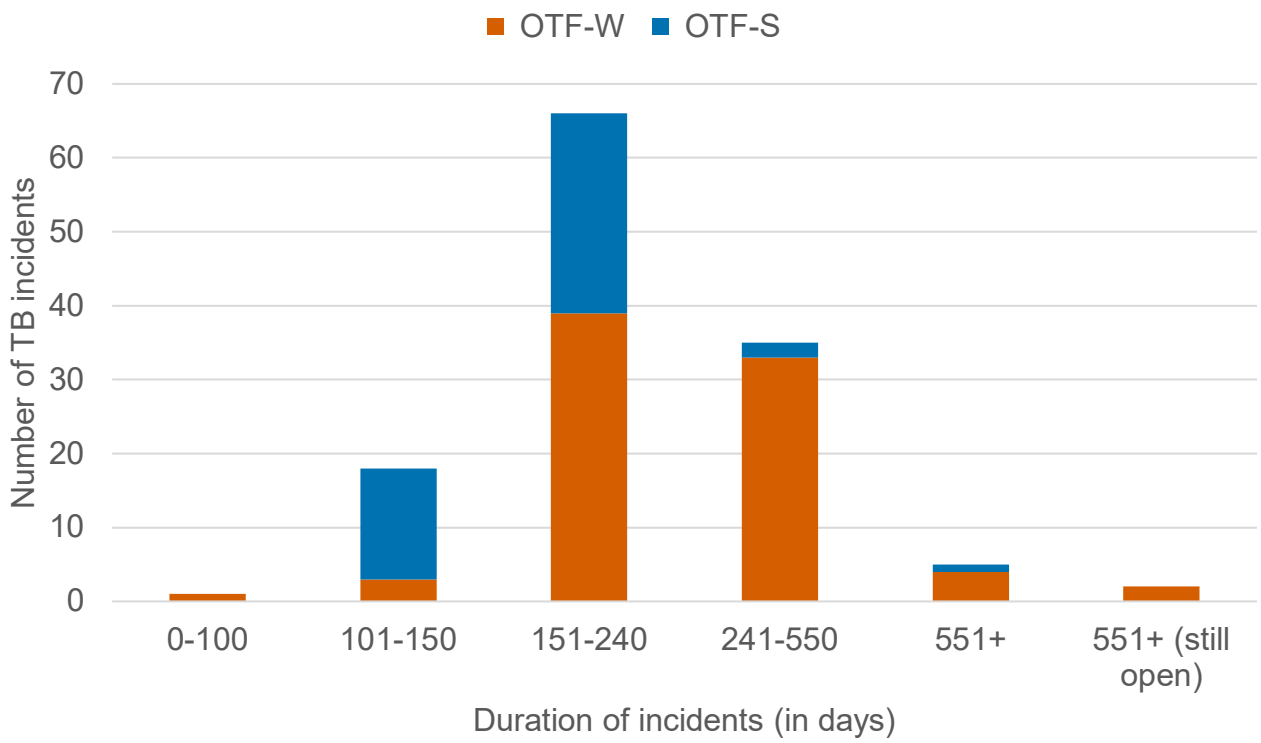


Figure 11: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2020, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2020 in Derbyshire. Note that Approved Finishing Units (AFUs) have been excluded.

There were seven persistent TB incidents (those with a duration of over 18 months) in 2020 which is fewer than in the previous year (nine in 2019). All seven incidents were located in the former HRA portion of Derbyshire and affected large herds (dairy, beef suckler, and fattening). Five of these were resolved during 2020 and had a duration of 558 to 945 days.

For these five incidents, infection was most likely to have come from a wildlife source. Additionally, several non-compliances with TB legislation contributed to the length of one incident. Of the remaining two ongoing persistent incidents, one started in 2018 and one in 2019. Both incidents most likely originated from purchase of undetected infected cattle.

Genotypes associated with TB incidents

Genotyping of *M. bovis* isolates has been used to trace the origin of TB infection. It is particularly useful in identifying where spread has occurred through cattle movements. Stable genotype clusters tend to be found in areas where there is a persistent local reservoir of infection.

APHA implemented whole genome sequencing (WGS) in place of genotyping from April 2021. During 2020 however, genotyping was still performed on *M. bovis* samples isolated from all OTF-W herds in the Edge Area.

Genotypes of *M. bovis* identified in cattle herds that sustained new OTF-W incidents in Derbyshire in 2020 are shown as a percentage in Figure 12. Genotype 25:a continues to be the most common genotype in Derbyshire representing 51 of the 68 isolates obtained in 2020.

This equates to 75% of all genotypes identified in 2020. The homerange for genotype 25:a includes the former HRA portion of Derbyshire and so would be expected to be the dominant genotype.

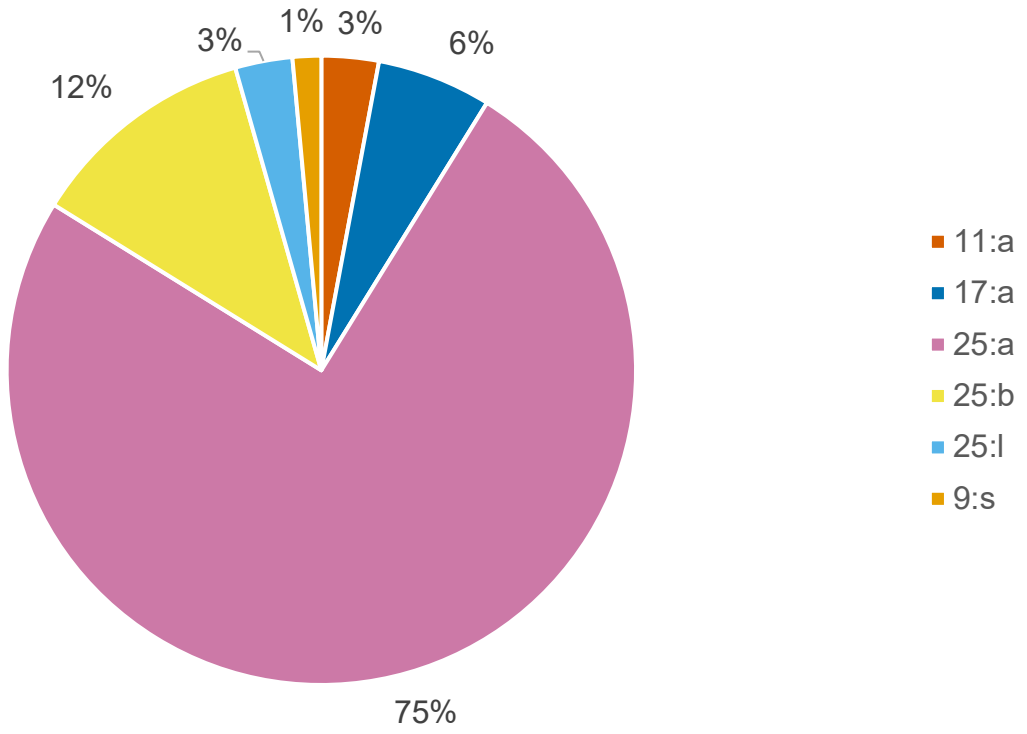


Figure 12: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Derbyshire in 2020 (n=68).

Genotype 25:b, which also has a homerange in the former HRA portion of Derbyshire, is the second most common with 8 occurrences (12%). This was followed by genotype 17:a with four occurrences (6%). This is similar to the data for 2019. Furthermore, there were two occurrences of genotype 25:l (3%), two more of 11:a (3%) and one of 9:s (1%).

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, Cheshire and parts of Shropshire and Leicestershire.

For this reason, it provides 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.

Unusual TB incidents

Except from the TB persistent incidents discussed above, there were no other unusual TB incidents in Derbyshire in 2020.

Suspected sources, risk pathways and key drivers for TB infection

Key drivers of infection

The key drivers of the TB epidemic in Derbyshire during 2020 were as follows:

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

Badgers are deemed to be a significant source of TB in Derbyshire 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 (see Figure 7) is an indication of endemic TB infection within the local wildlife population. This is a crucial driver of the epidemic in the county.

The TB Advisory Service (TBAS) launched in October 2017 and offers free bespoke advice to farmers on TB biosecurity. This 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 infectious 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), Farm Level Data Packs issued by APHA during incidents and other tools introduced to encourage safe sourcing of cattle like the interactive mapping tool ibTB 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 not fully eradicated by testing and removal of reactors during a previous herd incident.

Current diagnostic tools (including use of the supplementary 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 within infected herds.

Sources of infection and risk pathways

It can be challenging to retrospectively establish the route of infection for a TB incident herd. 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. This information is captured on the Disease Report Form (DRF).

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 is recorded as either definite (score 8), most likely (score 6), likely (score 4) or possible (score 1). Risk pathway data are explored both at the herd and county level.

The mostly likely source of infection in individual TB incidents

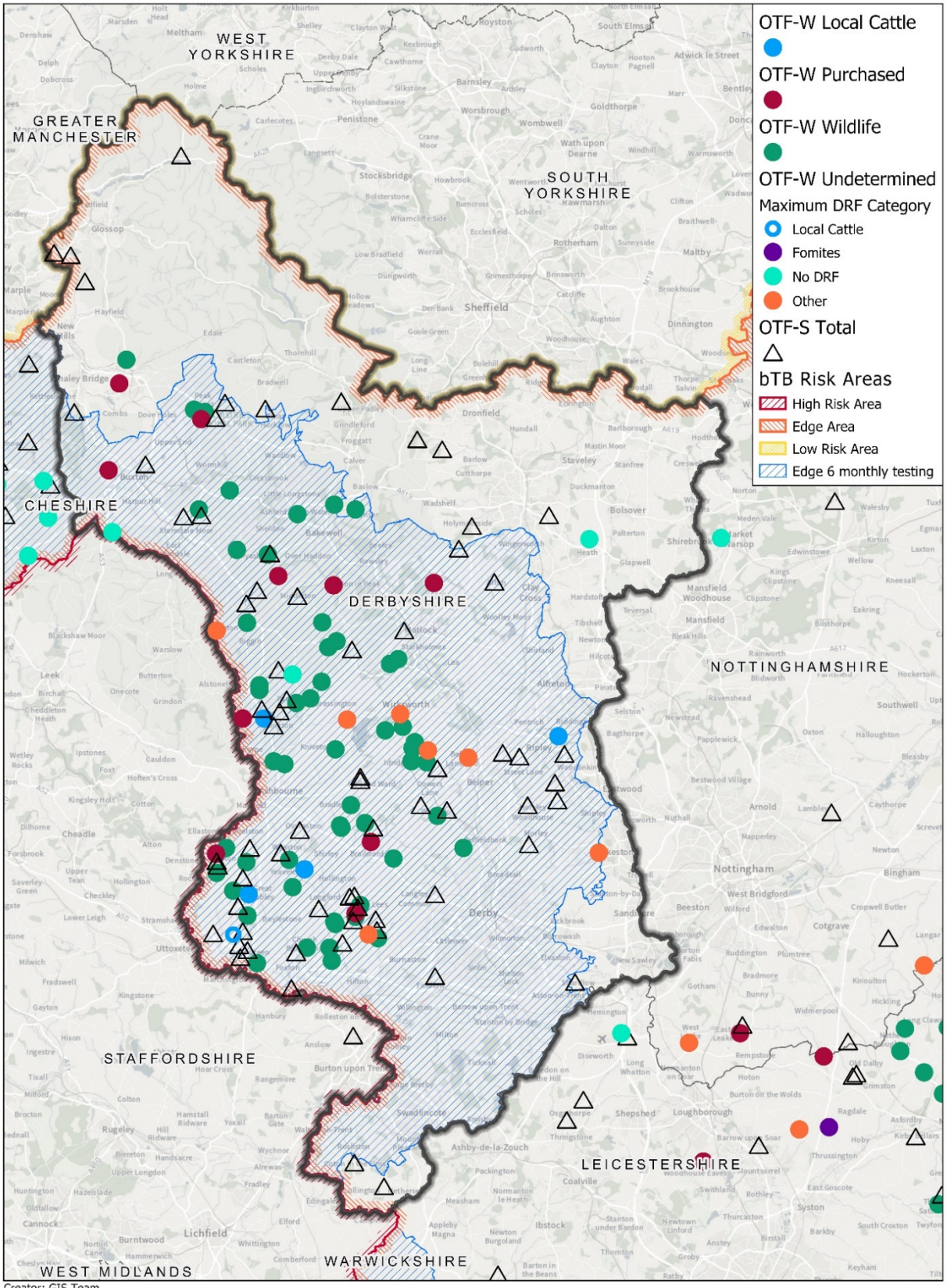
The most likely source identified by the APHA veterinary assessment is explored spatially for individual TB incidents. The most likely source of infection for individual TB incidents discounts additional risk pathways identified with a lower level of certainty.

Where two sources were ranked equally as the most likely source for an incident, both sources are reported for the incident using a split symbol in the map.

Based on the most likely source of infection recorded for all new incidents in Derbyshire in 2020, there continues to be a distinct abundance of incidents attributed mainly to a wildlife infection source in the south and west of Derbyshire (Figure 13).

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 or there are insufficient data available.



Creator: GIS Team
Source: Sam
OTFW data as at 15th of April 2021
Ref: 20210604
Date: 04/06/2021

DRF Source - Derbyshire

0 3.5 7 14 Kilometers

Animal & Plant Health Agency

The weighted source of infection at county level

To consider the contribution of all sources of infection within an area, the sources 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 into 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. This presents the overall proportion of pathways in which each source was identified, weighted by the level of certainty 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.

As illustrated in Figures 14a and 14b, wildlife continues to be the most likely source of infection reported in Derbyshire in 2020. Badgers as a source of infection were considered to be relevant in 57% of all analysed pathways, precisely 64% for OTF-W and 51% for OTF-S incidents.

There continues to be a reduction compared to previous years (77% recorded in 2018 and 61% in 2019) which is partly due to a more 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 (see Figures 7 and 13), 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 less than 1% of weighted risk pathways for OTF-W incidents and less than 4% for 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 2020.

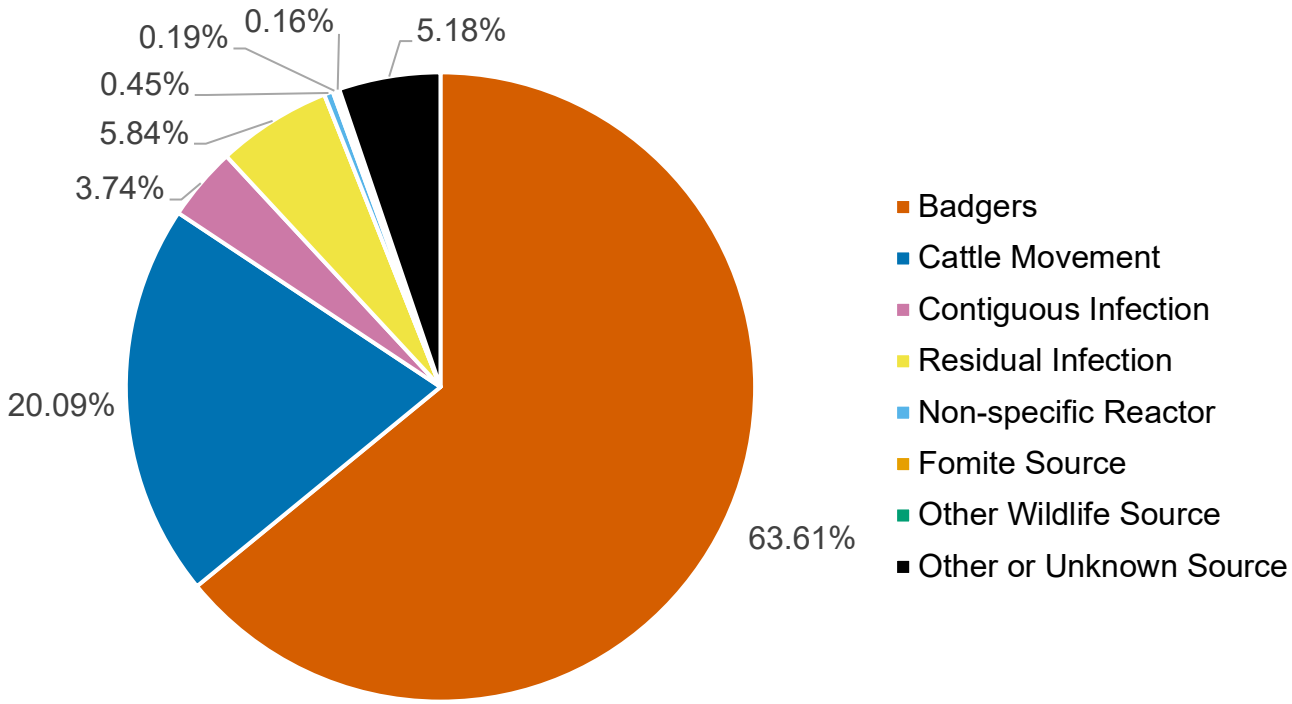


Figure 14a: Summary of the weighted source of infection pathways attributed for OTF-W TB incidents that started in 2020 in Derbyshire, that had a completed DRF (n=74).

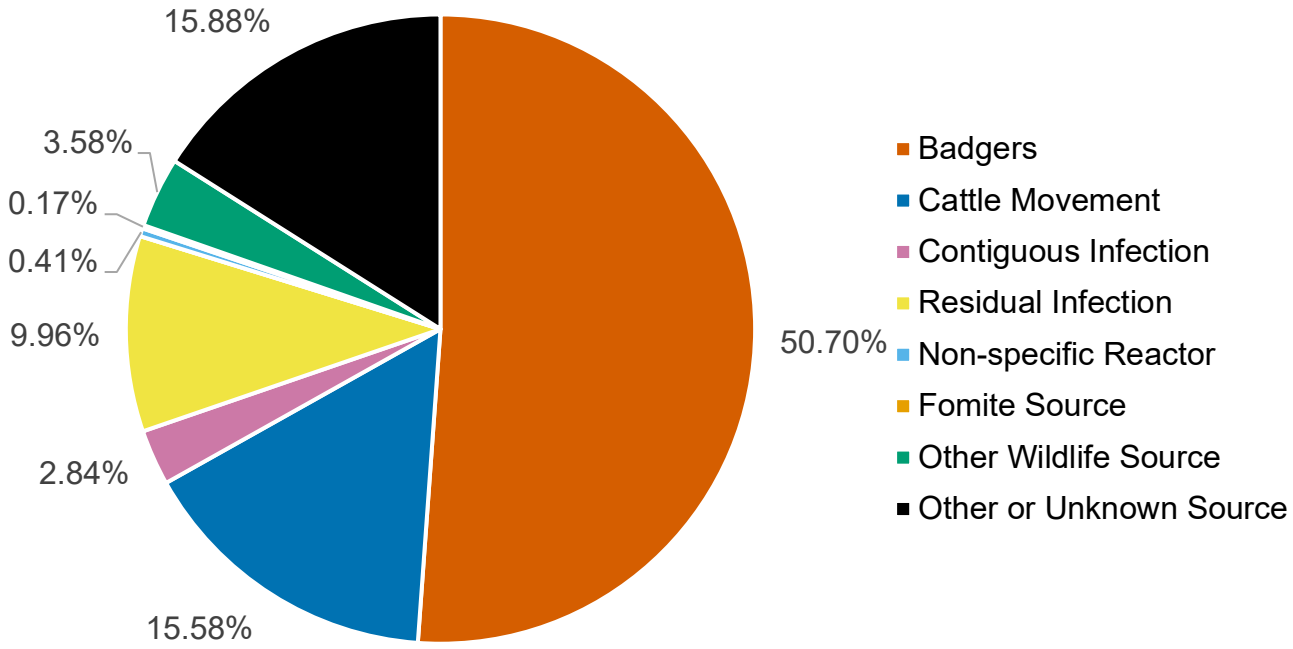


Figure 14b: Summary of the weighted source of infection pathways attributed for OTF-S TB incidents that started in 2020 in Derbyshire, that had a completed DRF (n=69).

Movement of undetected infected cattle was identified in 20% of risk pathways for OTF-W incidents and 16% of risk pathways for OTF-S incidents in 2020. There was an increase compared to the 16% recorded for OTF-W incidents in 2019 while there was a small decrease compared to the 18% recorded for OTF-S incidents in 2019.

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 the majority of genotypes detected are 25:a (see Figure 12) and that 25:a has a very wide 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 2020, liable for 6% of pathways identified in OTF-W incidents and 10% of pathways in OTF-S incidents. There was a marked decrease compared to the 14% identified in OTF-W incidents in 2019 and an increase compared to 3% identified in OTF-S incidents in 2019.

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.

The clear reduction observed in OTF-W incidents in 2020 compared to 2019 might be an indication of the successful use of IFN-γ testing in OTF-W incidents as it reduces the likelihood of leaving infected cattle behind and increases herd level test sensitivity when combined with the skin test.

Similar to 2018 and 2019, 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 alongside TB.

Many do not graze cattle in adjoining fields or may use paddock rotation to avoid neighbouring cattle being in contiguous fields at the same time.

The source of infection in approximately 10% of pathways in all new incidents in 2020 remained unknown (5% of OTF-W and 16% 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 genotype information is not available).

TB in other species

There is no statutory routine TB surveillance of live non-bovine species. Post-mortem examination (PME) is performed on suspected clinical cases reported to APHA. Furthermore, post-mortem meat inspection is carried out on all captive animals (for example, sheep, goats, pigs or deer) slaughtered for human consumption.

There was no laboratory confirmed isolation 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 2020.

Detection of TB incidents

In 2020, the majority of TB incidents (105 out of 147) continued to be disclosed by routine whole herd testing (WHT), as shown in Figure 15. This equates to 71% of all different surveillance methods and is higher than in 2019 (56%). 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.

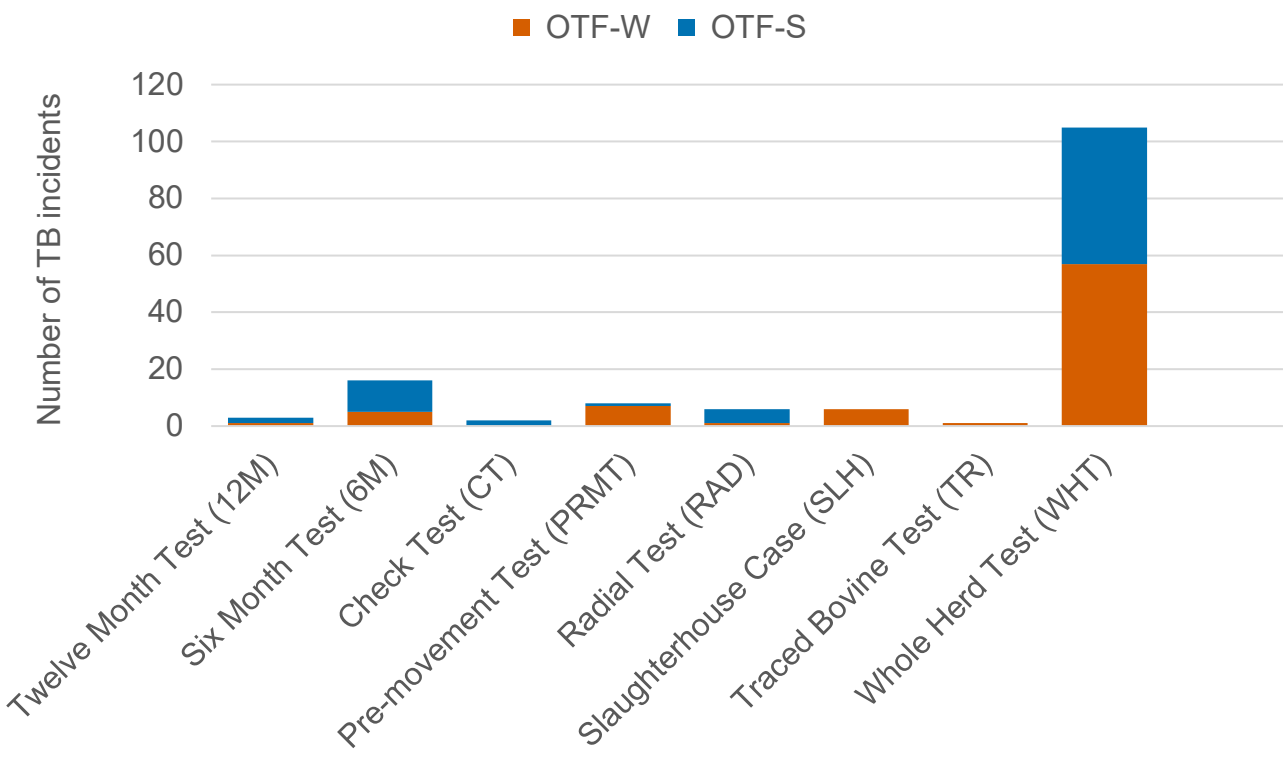


Figure 15: Number of TB incidents (OTF-W and OTF-S) in Derbyshire in 2020, disclosed by different surveillance methods.

The second most frequent type of test disclosing TB reactors was the six-month check test (6M) carried out six months after the conclusion of an incident. In 2020, 11% of incidents were disclosed at 6M testing compared to 21% in 2019.

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 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 eight incidents in 2020 were disclosed through pre-movement testing (PRMT) and six 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 six incidents in 2020 compared to ten incidents disclosed in 2019.

The number of incidents (OTF-S and OTF-W) that suffered an incident in the previous three years is shown in Figure 16. Half (39) of all new OTF-W incidents disclosed in 2020 ocurred on premised with a history of TB infection in the previous three years. Recurrence appears to be a relatively common problem in Derbyshire.

Figure 16 shows the number of new OTF-W and OTF-S incidents in 2020, that had experienced an OTF-W incident in the previous three years. It excludes new incidents that were also on restrictions in the first four or more months of 2020 due to an incident that started before 2020.

The Explanatory Supplement (see Section 4.3) provides more details on the reporting of recurrent TB incidents.

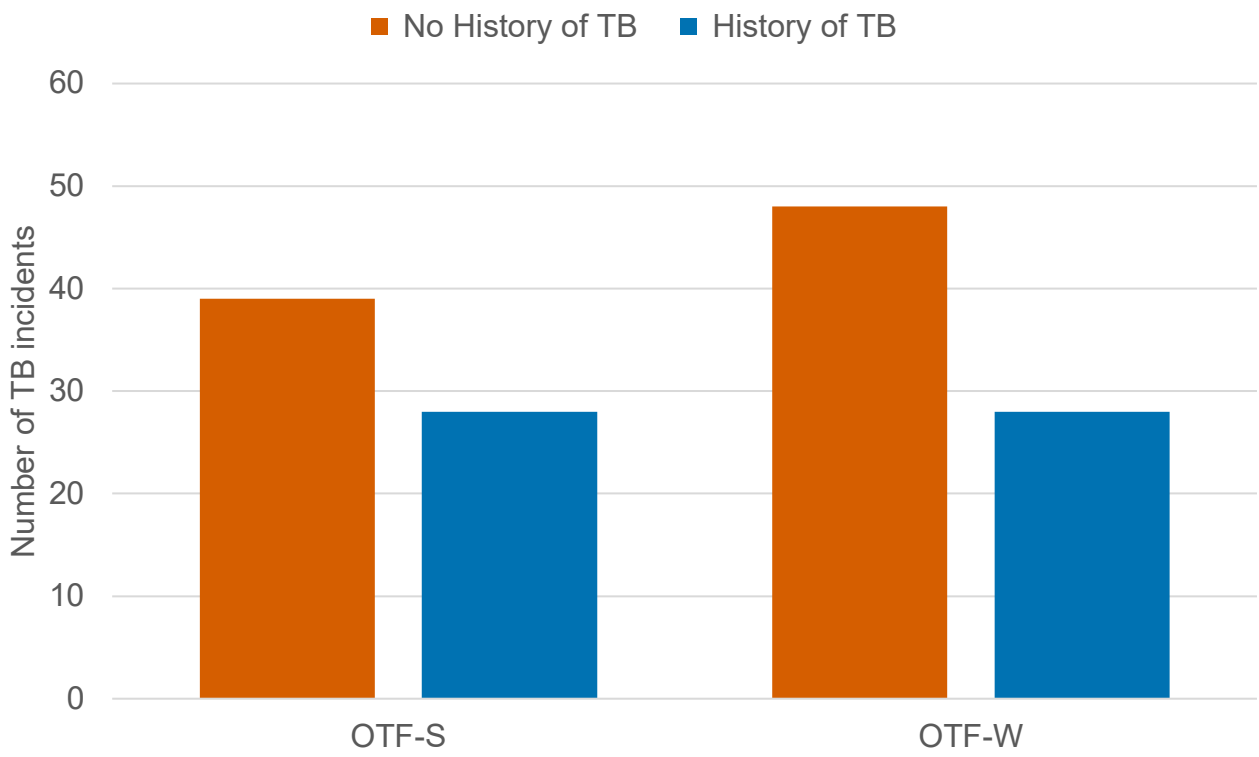


Figure 16: Number of herds with a TB incident (OTF-W and OTF-S) in Derbyshire in 2020, with a history of TB (herds that experienced an OTF-W incident in the previous three years), and holdings without a history of TB in the previous three years.

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 2011 to 2020.

A clear rise in numbers of reactors removed has occurred since 2015 until 2019 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 1,225 cattle were slaughtered in Derbyshire which is a small decrease when compared to the 1,291 cattle removed in 2019. This was mainly observed in the number of IFN-γ test positives, which dropped from 612 in 2019 to 534 in 2020. The number of skin test reactors in 2020 (691) has marginally increased compared to 2019 (679).

On an individual incident level, the average number of reactors removed per incident has also decreased from 11.3 in 2019 to 8.3 in 2020 (see Table A3.2).

The total number of new OTF-S incidents in 2020 (69) has doubled compared to 2019 (33) and this would partly explain the reduction in the number of IFN-γ test positives animals slaughtered as compulsory IFN-γ testing is applied to OTF-W incidents only.

Altogether, the above numbers distinctly display that TB in Derbyshire continues to be a financial burden for both industry and taxpayers.

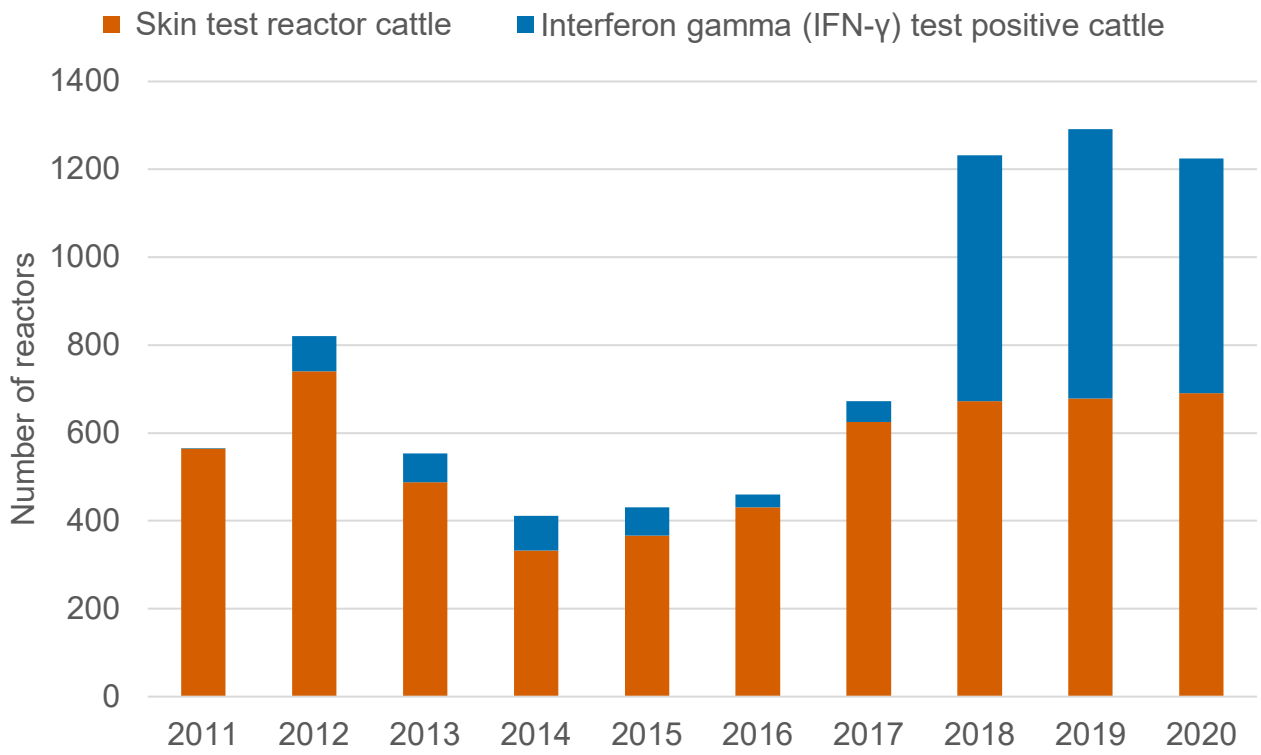


Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Derbryshire, 2011 to 2020.

Summary of risks to Derbyshire

The summary of risks to Derbyshire remains unchanged from 2019, 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

Effectiveness of controls

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 is succeeding in identifying and removing infected cattle more rapidly.

However, there continues to be 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 species.

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 are necessary to support these enhanced cattle measures and enable removal of as much infection as possible. Badger control operations took place in one control area of Derbyshire in 2020.

See the Summary of 2020 badger control operations for more details. The Badger Edge Vaccination Scheme (BEVS) was also ongoing in Derbyshire in 2020 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 TBAS, and access to the TB Hub website.

Anecdotally, farmers' understanding of different aspects of the ecology of the disease is improving and this is helping them to recognise and implement appropriate biosecurity measures. Awareness of the importance of informed cattle purchasing is also increasing, aided by the availability and use of the interactive mapping tool ibTB.

Forward look

With the current measures remaining in place for the near future, there is more optimism about achieving a good reduction in TB in Derbyshire in the longer term. However, given the present figures, it seems unlikely for Derbyshire 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 as published in 2014.

Appendices

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

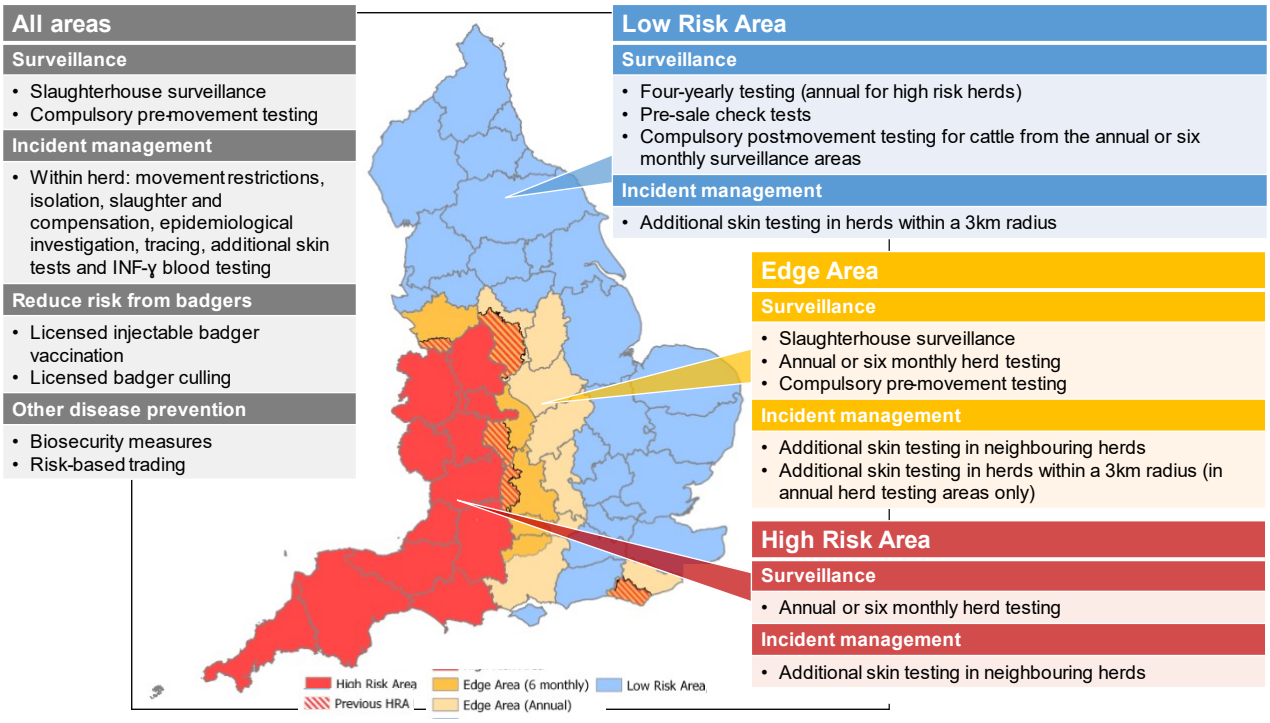


Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Tuberculosis-Free Status for England. The map is described in more detail in the Explanatory Supplement for England 2020.

Policy objectives for the Edge Area

Short to medium term:

- slow down geographic spread of endemic infection
- maintain crude herd incidence of OTF-W incidents less than 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 less than 1% by 2025
- attain OTF status (crude incidence of indigenous OTF-W herd incidents less than 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:

- A strategy for achieving officially bovine tuberculosis free status for England
- Government sets out next phase of strategy to combat bovine tuberculosis

Key Control Measures

Surveillance:

- six monthly or annual routine whole 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 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 ('resolved IRs' policy). The only permitted movements of these animals are to slaughter or an Approved Finishing Unit, or after being subjected to a private IFN-γ test with negative results

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 2020.

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 2020. (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	12	758	252	264	137	66	45	1,534	108	50

***The number of herds with an undetermined size.**

Table A2.2 Number of animals by breed purpose in Derbyshire at 1 January 2020.

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of cattle	90,917 (55%)	67,581 (40%)	6,597 (3%)	5 (less than 0.01%)	165,100

Appendix 3: Summary of headline cattle TB statistics

Table A3.1 Herd-level summary statistics for TB in cattle in Derbyshire between 2018 and 2020.

Herd-level statistics	2018	2019	2020
(a) Total number of cattle herds live on Sam at the end of the reporting period	1,736	1,740	1,737
(b) Total number of whole herd skin tests carried out at any time in the period	2,446	2,363	2,261
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	1,486	1,445	1,429
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of Notice Prohibiting the Movement of Bovine Animals (TB02) restrictions)	1,564	1,609	1,542
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	1,637	1,655	1,632
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	142	114	147
• OTF-S	58	33	69
• OTF-W	84	81	78
(g) Of the OTF-W herd incidents:			
• How many can be considered the result of movement, purchase or contact from or with an existing incident based on current evidence?	20	11	18

Herd-level statistics	2018	2019	2020
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	49	39	57
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (such as, forward and back-tracings, contiguous, check tests)	5	32	15
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	11	10	6
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	5	1	1
• OTF-W	1	4	2
(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)	67	64	59
(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	10	12	13
• Exempt Finishing Units: Grazing	2	2	2
• Exempt Finishing Units: Non-Grazing	4	4	4

Table A3.2 Animal-level summary statistics for TB in cattle in Derbyshire between 2018 and 2020.

Animal-level statistics (cattle)	2018	2019	2020
(a) Total number of cattle tested in the period (animal tests)	345,615	327,754	314,945
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	673	679	691
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	559	612	534
(c) Reactors detected during year per incidents disclosed during year	8.7	11.3	8.3
(d) Reactors per 1000 animal tests	3.6	3.9	3.9
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	33	12	9
• Private slaughters	12	12	9
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	15	25	14
(g) SLH cases confirmed by culture of *M. bovis*	12	11	6

Note: (c) Reactors detected during year per incidents disclosed during year, reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count here.

Note: (g) SLH cases confirmed by culture of *M. bovis*, 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 the new OTF-W and OTF-S incidents identified in the report period

Table A4 Suspected sources of *M. bovis* infection for all the new OTF-W and OTF-S incidents identified in Derbyshire, in 2020.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	59	54	72	2	57.8%
Cattle movements	38	19	14	3	18.1%
Contiguous	25	5	0	0	3.4%
Residual infection	20	7	10	0	7.9%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	4	0	0	0	0.4%
Fomites	2	0	0	0	0.2%
Other wildlife	10	3	0	0	1.8%
Other or unknown source	2	0	0	0	10.4%

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**.

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