Animal & Plant Health Agency

Year-end descriptive epidemiology report:

Bovine TB in the Edge Area of England

County: Leicestershire

Year-end report for: 2019

Contents

Executive summary

Reporting area

Leicestershire 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 Leicestershire.

Local cattle industry

Small family-run beef herds predominate in Leicestershire, however there is a significant number of large dairy herds in the county.

New incidents of TB

The annual incidence rate decreased by 0.3 in 2019 to 6 incidents per 100 herd-years at risk. There were 50 new incidents detected in 2019, a reduction from 59 incidents in 2018. This decrease involved incident herds with OTF Status Suspended (OTF-S), which dropped from 37 in 2018 to 28 in 2019. The number of OTF Status Withdrawn (OTF-W) incidents (22) remained unchanged on the year.

Suspected sources and risk pathways for TB infection

Badger-related risk pathways accounted for 45.4% of the weighted contribution of all risk pathways considered. This represents a 5% decrease from 2018. The majority of incidents attributed to wildlife reservoirs are located in north-east Leicestershire, where disease is considered to be endemic. Movement of undetected infected cattle was the second main risk pathway accounting for 27.25 % of the weighted contribution of all risk pathways.

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

Almost 42% (21) of all new incidents in 2019 were disclosed by routine annual surveillance testing. A further 34% (17) of incidents were disclosed by radial testing (targeted surveillance of herds located within a 3km radius of a herd with an OTF-W incident). Only 6% (three) of all new incidents in 2019 were disclosed by passive (slaughterhouse) surveillance. This may be an indication that disease is being disclosed at an earlier stage through on-farm surveillance.

Reactor numbers

In total, 512 cattle were compulsorily slaughtered for TB control reasons in 2019, an increase of 111 compared to 2018. The increase in the total number of reactors removed compared to 2018 is attributable to the increased number of interferon gamma (IFN-γ) test positive animals detected and removed. In 2019 the skin test accounted for 205 reactors (204 in 2018) and the IFN-γ test detected 307 additional positive animals (197 in 2018).

Risks to the reporting area

The risk from the adjacent Edge Area counties remains the same as in the previous year. The two main risks to Leicestershire are movement of cattle from other Edge Area and HRA counties, and encroachment of endemic infection in wildlife reservoirs from neighbouring counties of Warwickshire and Northamptonshire.

Risks posed by the reporting area

The cluster of OTF-W TB incidents sharing genotype 25:a in north-east Leicestershire near the boundaries with south Nottinghamshire and west Lincolnshire are associated with wildlife infection and pose a significant risk to the adjoining Low Risk Area (LRA). These incidents occurred in the area known as potential hotspot area HS23.

Forward look

The measures needed to address the most common risk pathways for TB infection in Leicestershire are:

- evolving the strategy for prevention of spread of TB from wildlife reservoirs
- improving diagnostics, surveillance and epidemiology to detect and remove TB more effectively from cattle
- incentivising the uptake of effective biosecurity measures
- managing the risks posed by cattle movements

Introduction

This report describes the level of bovine tuberculosis in cattle herds in Leicestershire 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 Leicestershire, 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). Leicestershire 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.

The changes of January 2018 to the Edge Area boundary did not affect the county of Leicestershire. However, at that time Defra introduced radial skin testing of herds located within a 3km radius of a new OTF-W incident to enhance the cattle TB surveillance regime in Leicestershire and all the other parts of the Edge Area that remained on annual testing.

Cattle industry

Herd types

A total of 890 herds were registered in Leicestershire in 2019, 27 fewer than in the previous year (Appendix 2 Table A2.1). The total number of cattle in Leicestershire in 2019 was 117,005, a reduction of over 3,500 on 2018.

Small herds of up to 50 cattle predominate (46%), the majority being beef cattle (Figure 1 and Appendix 2 Table A2.2). In Leicestershire small beef herds tend to be family-run businesses that practise traditional husbandry based on winter housing and summer grazing.

A small proportion of herds (5%) number over 500 cattle, the majority of which are dairy units.

In Leicestershire there continues to be a predominance of beef cattle (61%) with dairy cattle representing 34% of cattle in the county (Appendix 2).

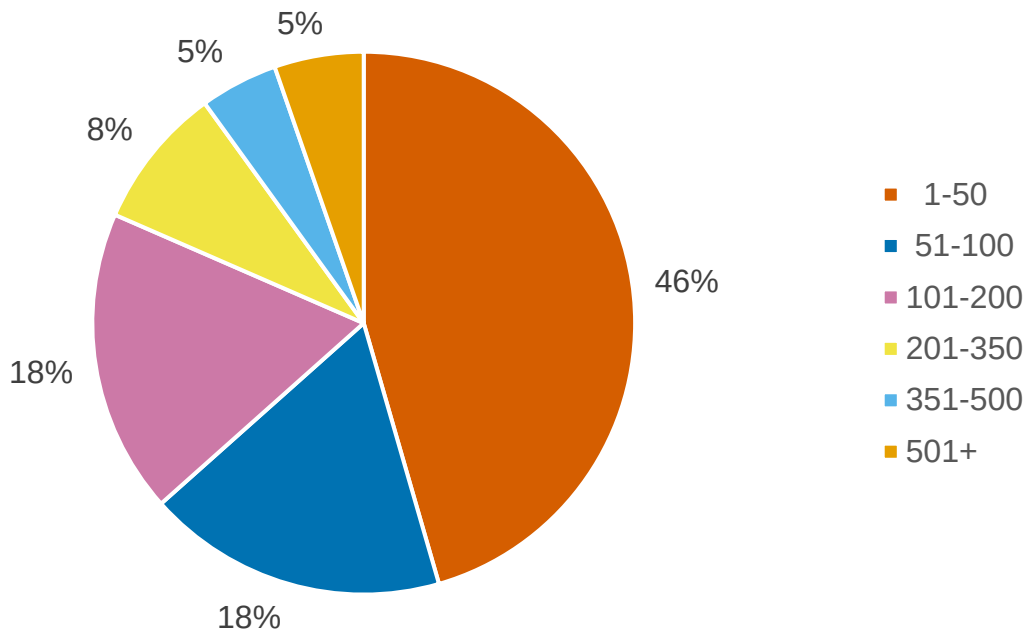

Figure 1: Proportion of cattle holdings by herd size in Leicestershire in 2019 (n=883).

Markets and shows

There is one livestock auction market in Leicestershire for cattle: Melton Mowbray Market. This market operates a pre-movement testing exempt market and in 2018 was also approved by APHA to hold dedicated sales for TB restricted cattle, commonly known as 'orange markets'. No such sales have taken place up to the end of 2019.

There were five livestock shows in Leicestershire during 2019.

Approved Finishing Units

One new Approved Finishing Units (AFU) was licensed in this reporting year, resulting in a total of 14 AFUs operational in the county. The cattle on these premises are permanently under movement restrictions, housed under strict biosecure conditions, exempt from TB testing and are moved off directly to slaughter when finished. These units do not have grazing and if correctly operated are not considered a risk for introduction or spread of TB into the surrounding areas.

Common land

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

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. Measures of incidence and prevalence in this report may be lower than those reported in the official TB statistics.

Leicestershire experienced a gradual increase in the annual number of new TB incidents recorded between 2013 and 2018 (Figure 2).

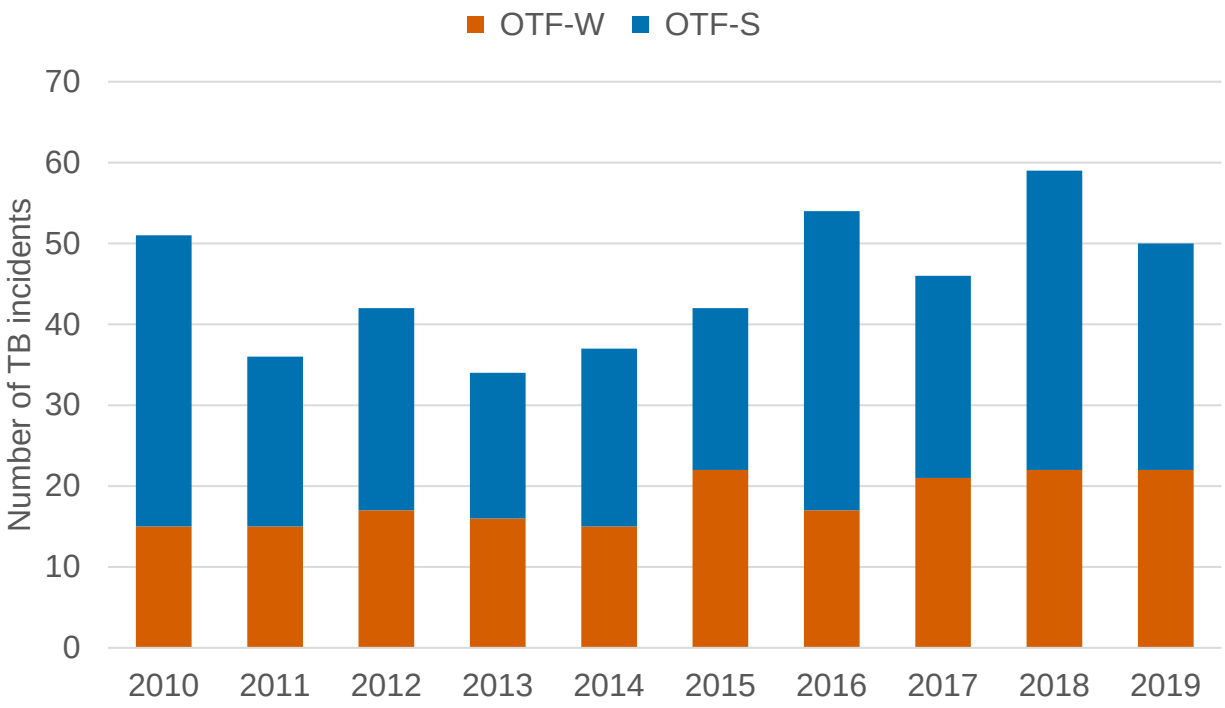

Figure 2: Annual number of new TB incidents in Leicestershire, 2010 to 2019.

The number of individual cattle tests increased by more than 10,000 in 2019 (from 179,171 in 2018 to 189,217 in 2019) as shown Appendix 3. Despite this, there was a 15% reduction in the number of new TB incidents in 2019 (50) compared to 2018 (59). This reduction in number was driven by a reduction in the number of OTF-S incidents from 37 cases in 2018 to 28 in 2019. The number of OTF-W incidents remained the same from 2018 to 2019 (22).

The annual incidence rate (incidents per 100 herd-years at risk) since 2010 increased from 3.0 in 2013 to 6.0 in 2019 (Figure 3). There was a slight reduction in the incidence in 2019 from 6.3 in the previous reporting year - a reflection of the reduction in the number of new TB incidents in 2019.

The herd prevalence at the end of 2019 demonstrates the burden of the disease during the report period as it takes into account both existing and new TB incidents. The prevalence of TB in Leicestershire had increased from 1.57% in 2015 to 3.48% in 2018, with a substantial decrease in 2019 to 2.53% (Figure 4). This increase in prevalence between 2015 and 2018 can be partly attributed to increased herd incidence and the more robust testing regime for TB incident herds in the Edge Area adopted in 2013 and 2014. At this stage it is too early to state that the present control measures have led to the 2019 reduction in prevalence. However, radial testing has resulted in earlier detection of disease and more sensitive testing (IFN-γ test) in OTF-W incident herds allows improved detection and removal of infected cattle. This should result in reduced chance of spread within and between herds and less residual cattle infection.

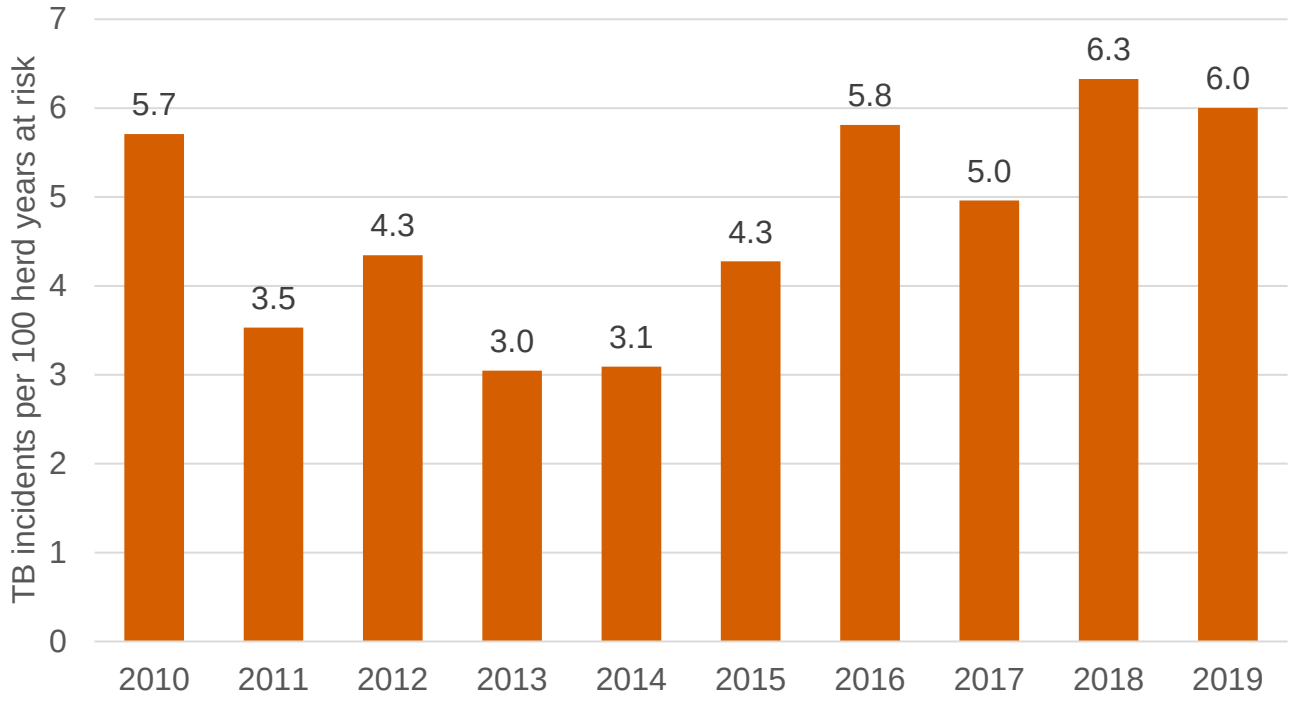

Figure 3: Annual herd incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Leicestershire, 2010 to 2019.

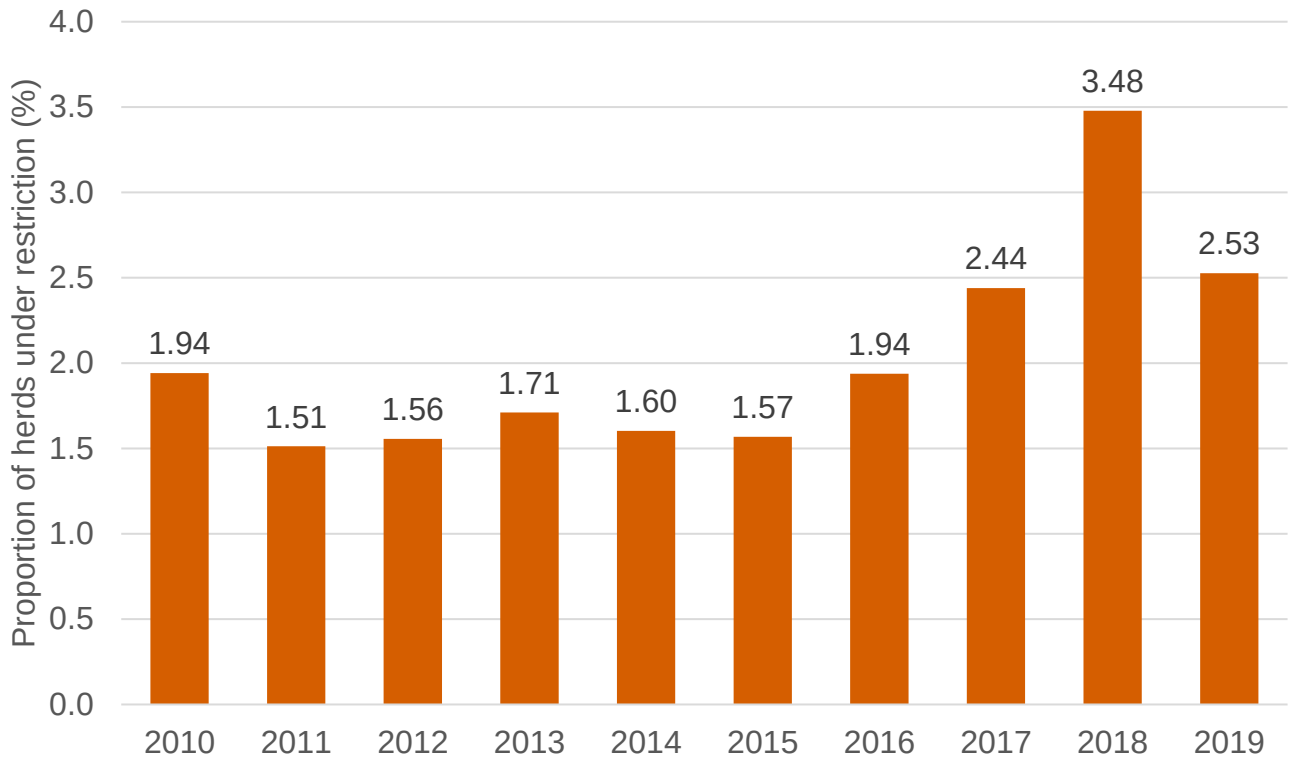

Figure 4: Annual end of year TB herd prevalence in Leicestershire, 2010 to 2019.

Geographical distribution of TB incidents

Leicestershire had the fifth lowest herd incidence rate (6.0 incidents per 100 herd-years at risk) of TB when compared to all Edge Area and HRA counties in 2019 (Figure 5). Despite the rising incidence in recent years, the county incidence rate is still lower than the overall average incidence rate in the whole Edge Area in 2019 (9.9).

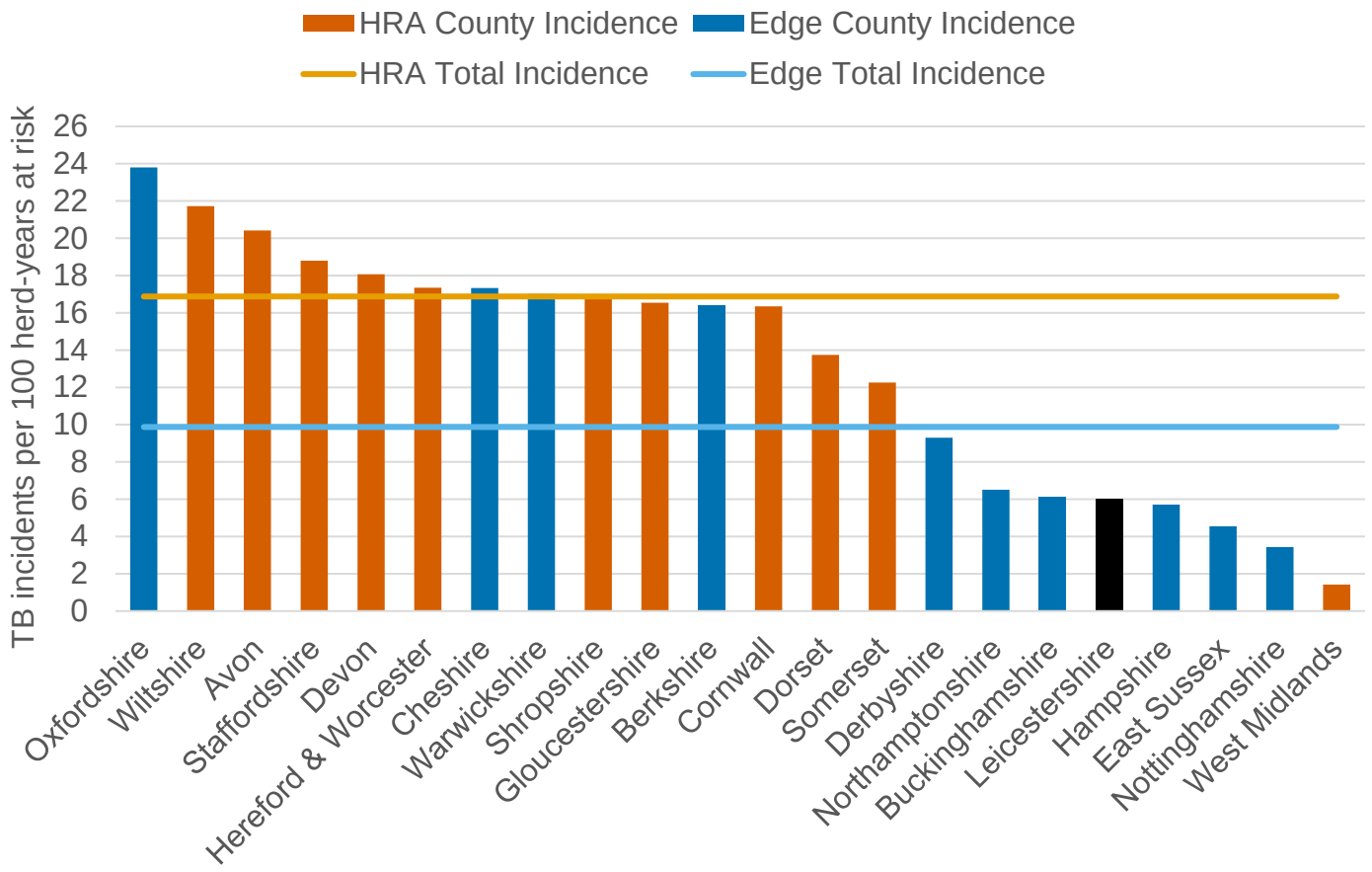

Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in 2019, by HRA and Edge Area County.

The geographical distribution of herds with new TB incidents in 2019 generally mirrors the density of cattle holdings in in Leicestershire and is similar to the distribution in 2018.

The majority of OTF-S incidents continued to be disclosed in south-west Leicestershire (Figure 6a). OTF-W incidents predominate in north-east Leicestershire near Melton Mowbray, with a similar distribution in 2018 and 2019 (Figure 6b). This cluster of OTF-W incidents is situated near the county's boundaries with both Lincolnshire and Nottinghamshire, was first recorded in 2015 and is part of the potential HS23. It has persisted throughout the years and has a relatively high proportion of culture-confirmed incidents with genotype 25:a of *M. bovis* attributed to a local wildlife reservoir. Since 2016 there has been an increase of genotype 25:a isolates in Leicestershire, from six cases in 2016 to ten cases in 2019. Of the ten cases of genotype 25:a isolates in 2019, eight TB incidents had been attributed to wildlife origin.

There has been one new incident in the north-west of the county in 2019 near the border with Derbyshire, but overall a decrease in the number in this area since 2016.

Two new TB incidents were identified this year in the south-east of the county near Uppingham close to the Northamptonshire border, the first cases in this area in the last five years. One of the cases was OTF-W and was assessed as of purchased origin whilst the neighbouring farm had an OTF-S case of unknown origin. Both cases have now been resolved.

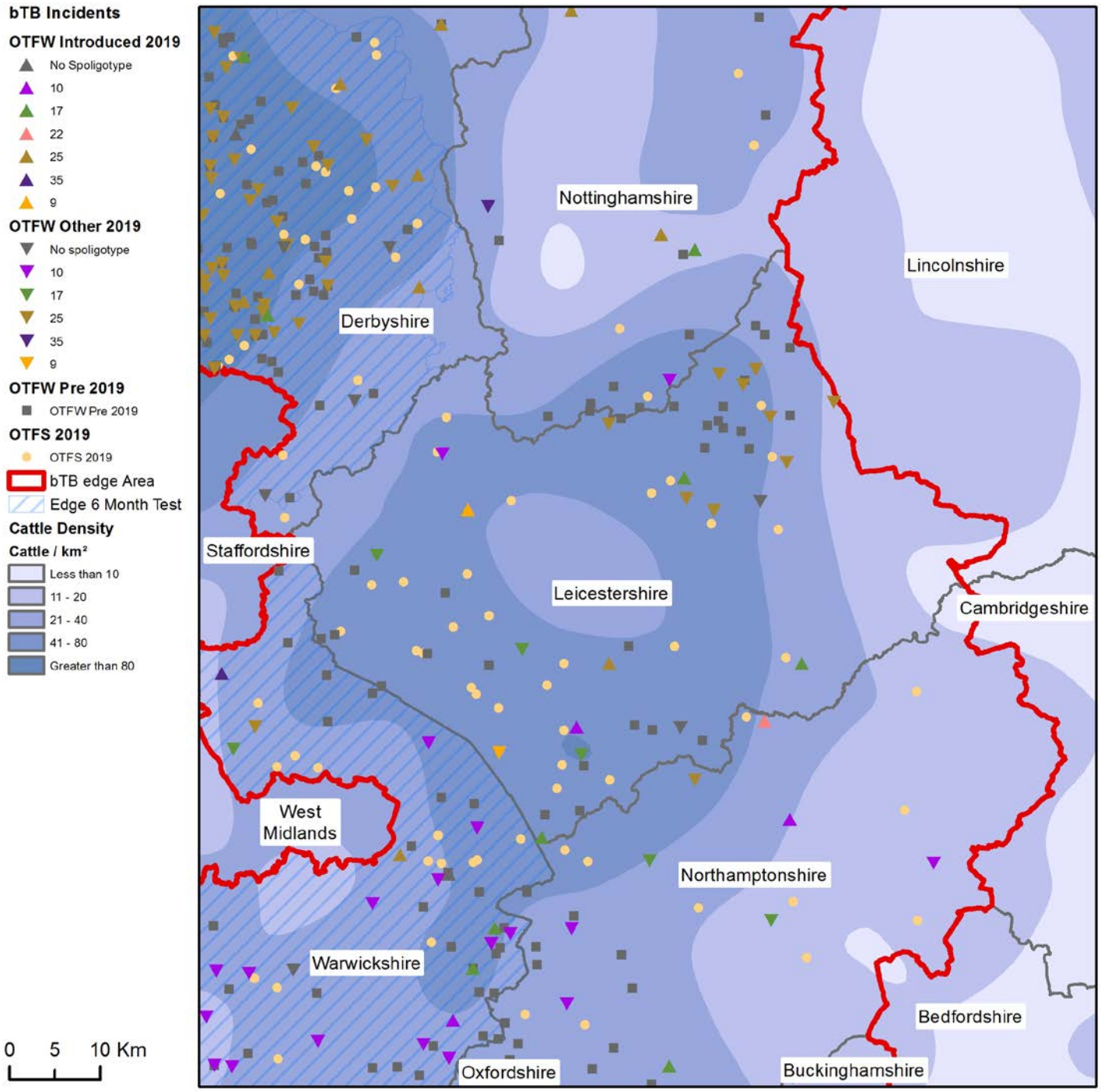

Figure 6a: Location of cattle holdings in Leicestershire with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the beginning of 2019, overlaid on a cattle density map. To note, ‘OTF-W Introduced 2019’ refers to OTF-W incidents in which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

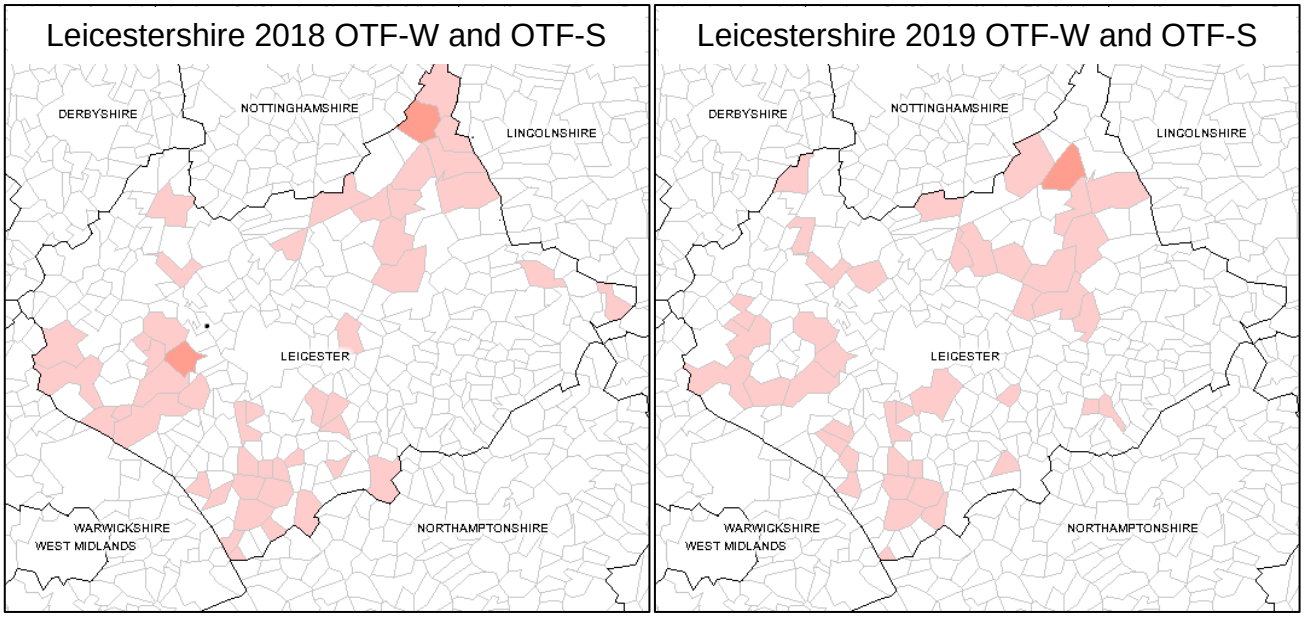

Figure 6b: Geographical distribution of all new TB incidents (OTF-W and OTF-S) in 2018 and 2019.

An indication of endemic *M. bovis* infection in local wildlife populations is provided by mapping the location of genotypes detected in Leicestershire where a wildlife source was attributed with a 75% certainty or above (Figure 7).

In 2015, a TB cluster sharing the same genotype 25:a was detected in a parish in the north east of Leicestershire. All incidents in this area were associated with wildlife infection. Since 2015 there has been an emerging area where the cluster of TB incidents associated with wildlife sharing the same genotype 25:a has increased mainly moving north-east of the county towards the boundary with Lincolnshire. This area is dominated by genotype 25:a and there is increasing evidence of disease being endemic in this part of Leicestershire.

The map in Figure 7 shows the incident distribution in 2019 within the cluster providing evidence that disease is potentially endemic in this area. It also reflects its proximity to the LRA of Lincolnshire. As a result, in June 2018, APHA set up a potential TB hotspot area straddling north-east Leicestershire and south-west Lincolnshire, known as HS23. Additional TB surveillance measures for cattle herds and wildlife (badgers and wild deer) are in force within this area. For more information see the section on risks to neighbouring areas in this report and the 2019 descriptive TB epidemiology report for Lincolnshire.

In 2018, four OTF-W cases in north-east Leicestershire were detected where wildlife was attributed with a 75% certainty or above and this increased to seven cases in 2019 and is an indication of expanding endemicity within the local wildlife populations.

The genotype 25:a cases potentially associated with wildlife appear clustered with similar cases in Lincolnshire in the potential hotspot area (HS23) in the bordering LRA in Lincolnshire.

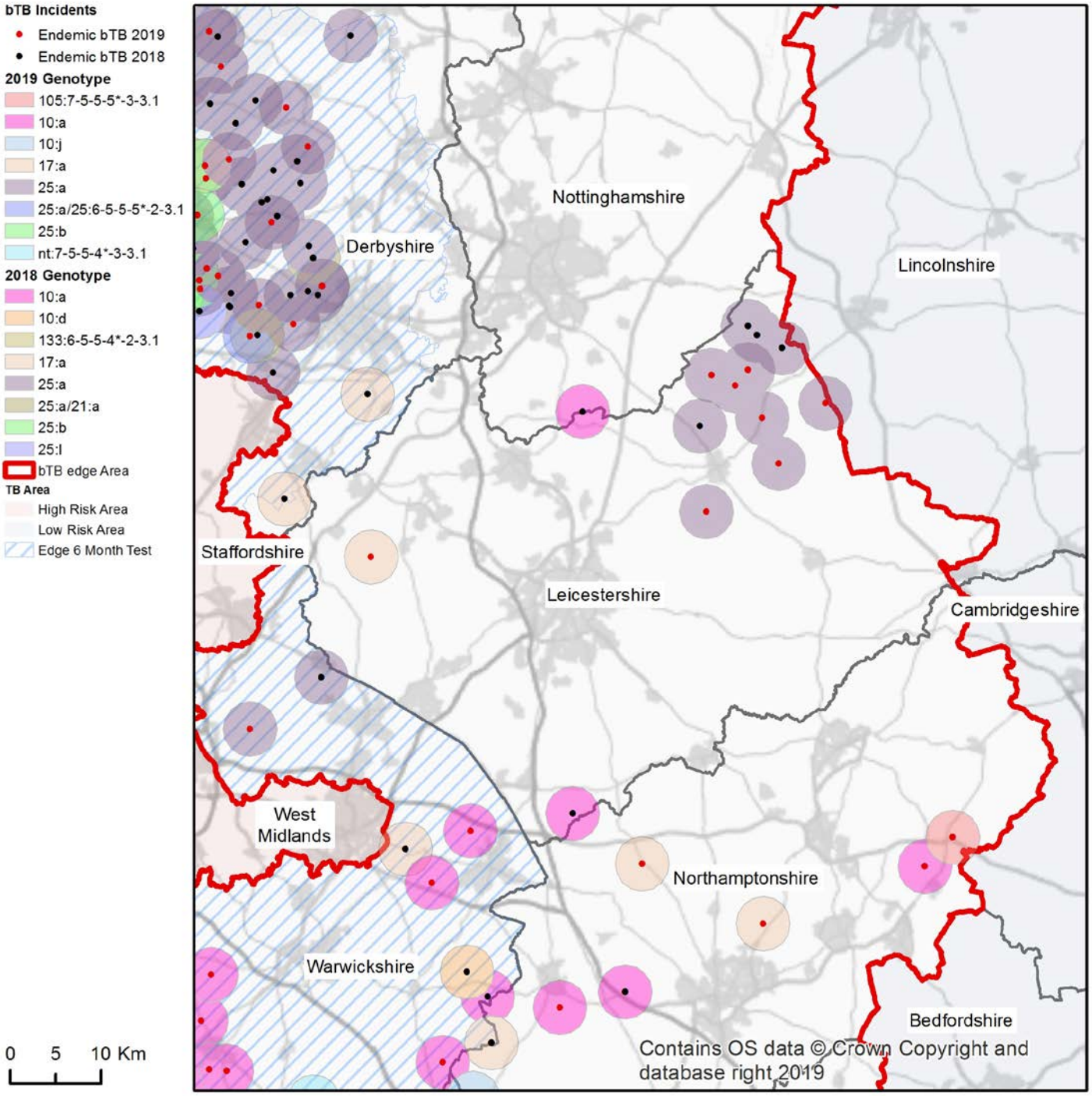

Figure 7: Genotypes of *M. bovis* detected in Leicestershire in 2018 and 2019, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemic infection within local wildlife populations (OTF-W incidents only).

The source of infection with the highest level of certainty recorded for all TB incidents (OTF-W and OTF-S) that started in 2019 is shown in Figure 8. Despite the general reduction in the number of TB incidents associated with wildlife in Leicestershire as a county, there has been an increase in this risk pathway in the north-east of the county. There is again a distinct cluster of incidents attributed to wildlife in the north-east of the county. The assessment of the source of infection is more accurate in herds with OTF-W incidents, in which *M. bovis* has been isolated from tissue samples in the

laboratory and genotype data is available. Genotyping is an important tool to support the analysis of specific transmission pathways.

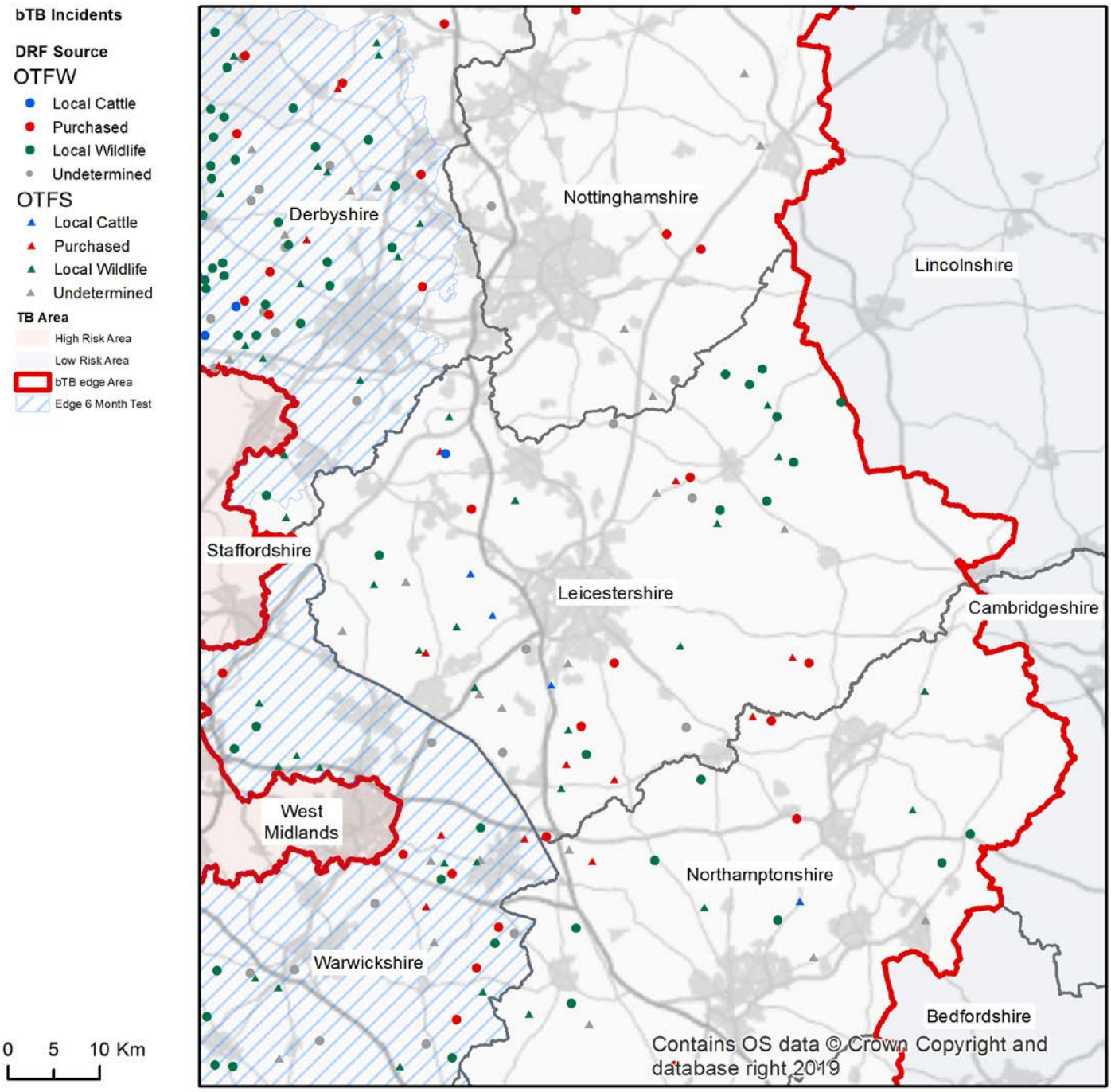

Figure 8: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Leicestershire, and its adjoining Edge Area counties, which started in 2019.

The distribution of the OTF-W herds in 2018 and 2019 is very similar. There has been a change in the north-east of Leicestershire where the cluster of OTF-W cases attributed to wildlife has spread further to the east and south of Melton Mowbray.

The vast majority of the OTF-W attributed to the movement of infected cattle are more sporadic and have a patchy distribution mainly in the south of the county.

TB incidents of undetermined source are distributed throughout the county. These cases are unable to be assessed with certainty because the incident may not yet have resolved or there may be insufficient data available.

Other characteristics of TB incidents

Incidents by herd types

The number of TB incidents which were disclosed in 2019 in Leicestershire is shown in Figure 9, described by cattle herd size and type of production. These figures are similar to the previous reporting year (2018).

- Beef suckler: 26% (13) of all TB incidents, of which 46% were OTF-W
- Beef fattener: 28% (14) of all TB incidents, of which 50% were OTF-W
- Dairy sector: 46% (23) of all TB incidents, of which 39% were OTF-W

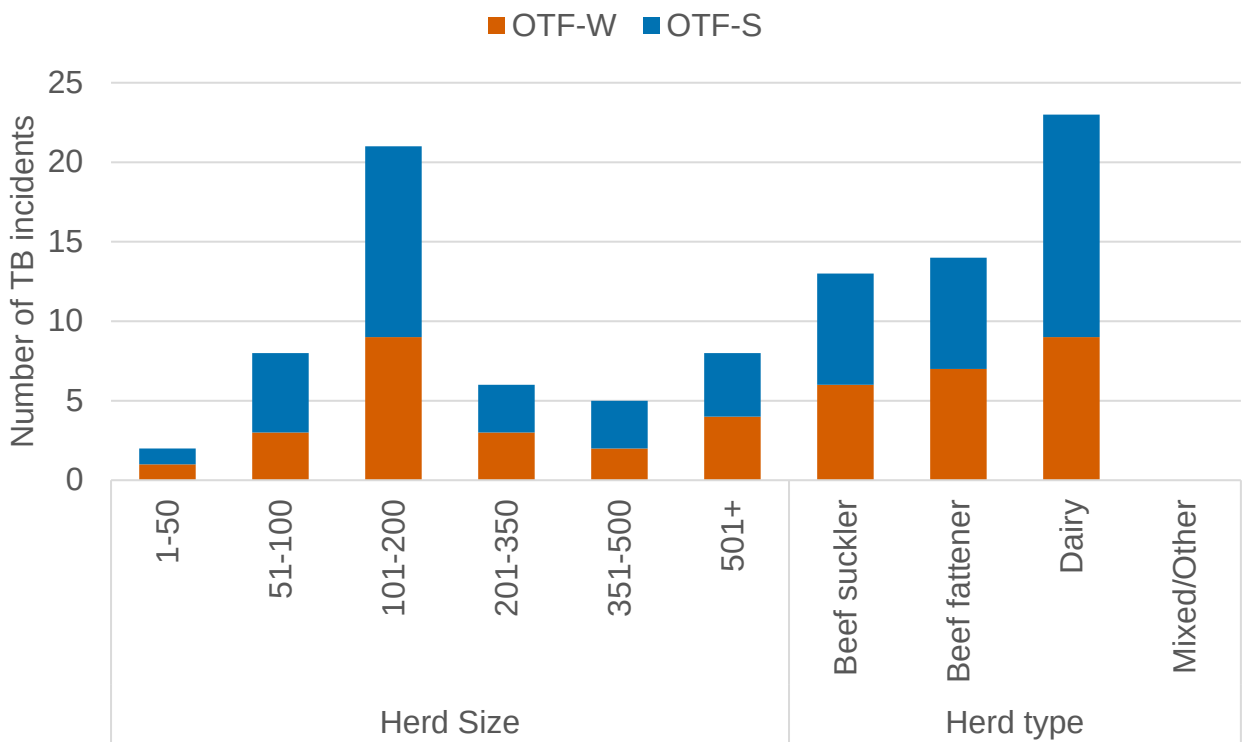

Figure 9: Number of new TB incidents (OTF-W and OTF-S) in Leicestershire in 2019, by cattle herd size and type.

The occurrence of TB incidents was more frequent in medium herds (101-200 cattle), with 42% of all TB incidents in 2019. This herd size represents only 18% of cattle holdings in Leicestershire in the same period.

Herds with more than 501 cattle accounted for 16% of all TB incidents but represent only 5% of all herds in the county. Small herds (1-50 cattle) accounted for 4% of all TB incidents but represent 46% of all herds in Leicestershire.

Herd size has been consistently and positively associated with the probability of a TB incident; the number of contacts and hence the probability of transmission increases with herd size. Larger herds tend to have more fragmented holdings which increases the risk of being exposed to other herds as well as to other types of wildlife.

Incidents by month of disclosure

As shown in Figure 10, there was a peak of new TB incidents disclosed in January (nine) and a second peak in April (seven) and May (seven) in 2019.

In previous reporting years there has been a more distinct peak in the winter housing period. The introduction of radial testing in 2018 has contributed to a more even distribution of incidents disclosed throughout this reporting year.

No data is available to show the distribution of surveillance testing throughout the year and so it is difficult accurately attribute reasons for the distribution of incident disclosure other than that the increase could be due to a greater number of tests being completed during those particular months.

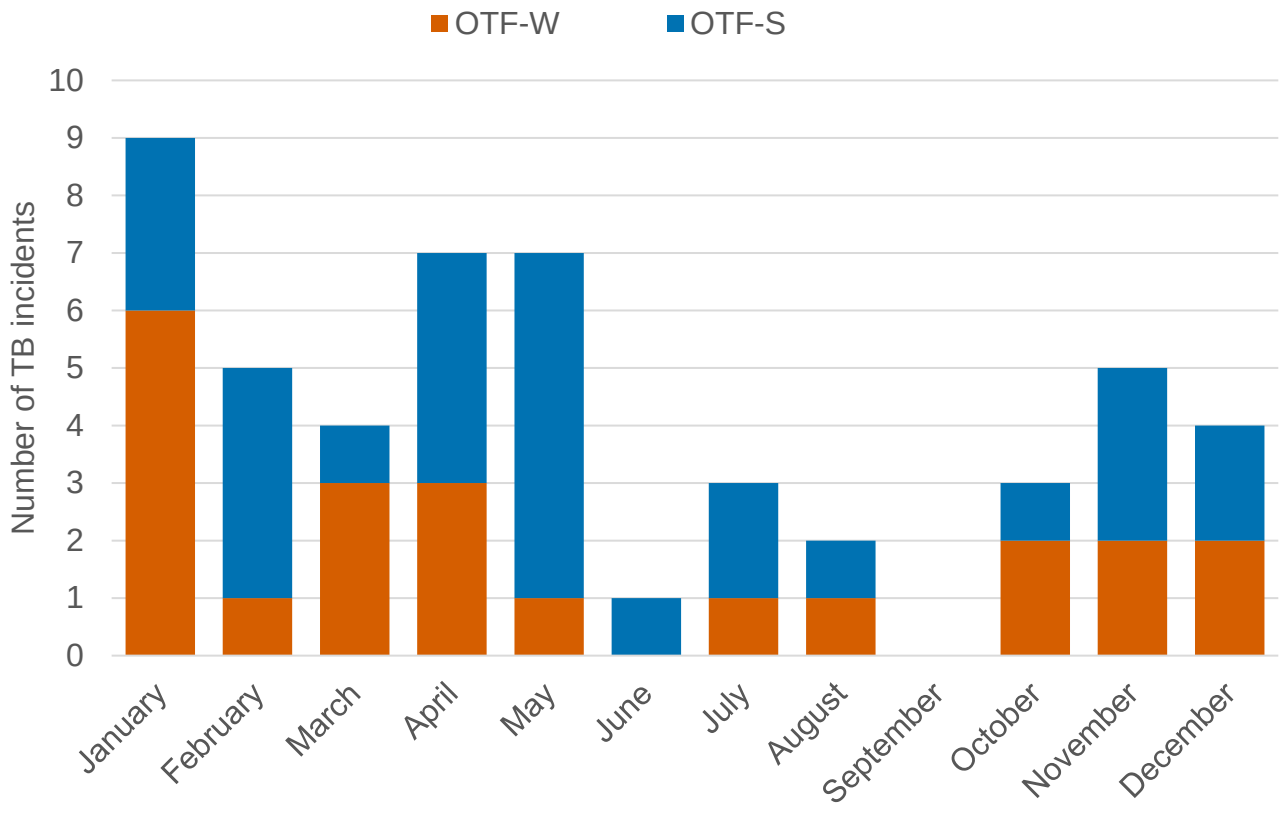

Figure 10: Number of new TB incidents (OTF-W and OTF-S) in Leicestershire in 2019, by month of disclosure.

Genotypes of *M. bovis* isolated

Genotype 25:a of *M. bovis* is endemic in the neighbouring counties of Staffordshire (HRA) and Derbyshire (Edge Area). In Leicestershire it has been identified in nine of the 18 isolates obtained in 2019 (50% of all genotypes identified in that year) (Figure 11a). It has been increasingly identified in OTF-W cases in Leicestershire in preceding years: 2016 (35%), 2017 (55%), and 2018 (60%).

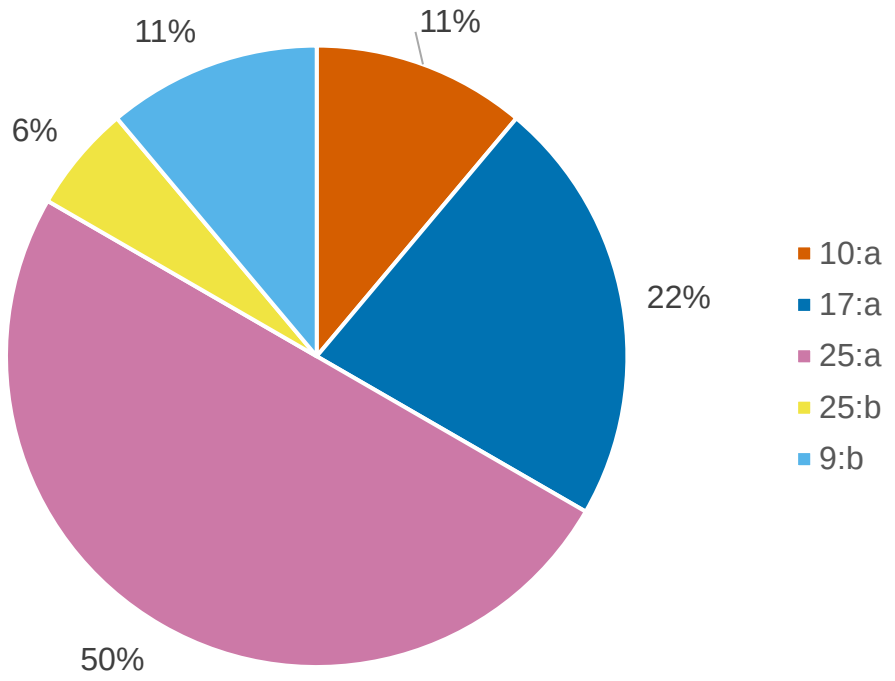

Figure 11a: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Leicestershire in 2019 (n=18).

The geographical distribution of genotype 25:a in Leicestershire in 2019 is similar to the distribution from 2016 to 2018 (Figure 11b), with the majority of incidents with this particular genotype being disclosed in the north-east of the county near the boundary with the LRA county of Lincolnshire. Wildlife is potentially the source of infection in the majority of OTF-W incidents in this area.

There was only one case with genotype 25:a identified in an incident in south Leicestershire. The infection pathway is unclear and there is no evidence of disease being endemic in this area of Leicestershire.

There has been an increase in the proportion of genotype 17:a isolates this year from 11% (two) in 2018 to 22% in 2019 (four). This genotype is randomly distributed throughout the county and is not associated with endemicity: three of these OTF-W incidents are clearly attributed to the purchase of cattle with undisclosed infection, and one was attributed to possible badger infection (Figure 11c).

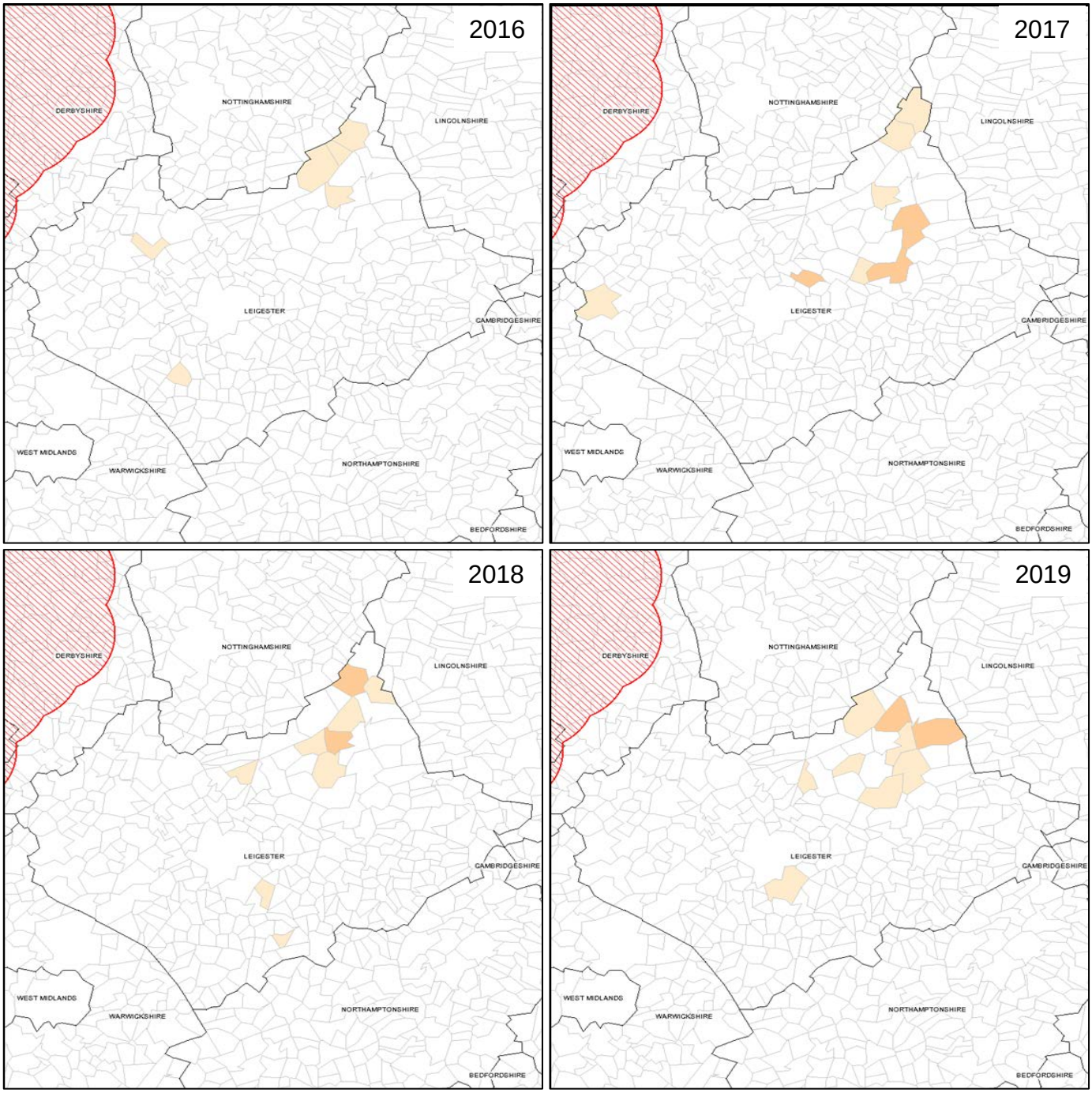

Figure 11b: Distribution of OTF-W cases with genotype 25:a in Leicestershire from 2016 to 2019.

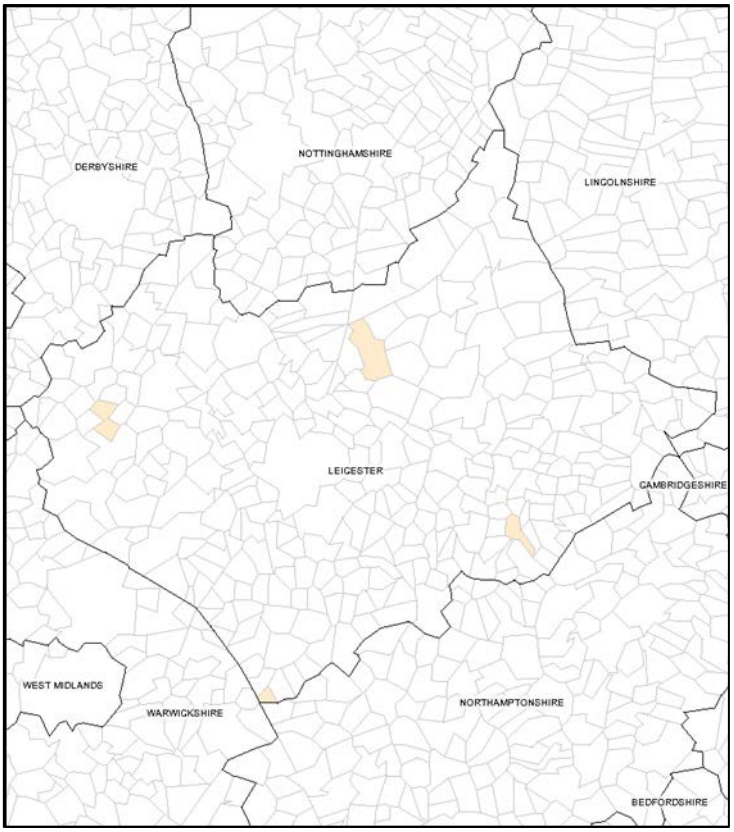

Figure 11c: Distribution of OTF-W cases with genotype 17:a in Leicestershire in 2019.

Duration of incidents

The majority of all TB incidents which ended in 2019 lasted from 151 to 240 days (Figure 12). There were two persistent incidents (those with a duration of over 18 months) ongoing in 2019, one of which resolved during the course of the reporting year with a total duration of almost 20 months. The resolved incident (disclosed at an inconclusive reactor retest following a whole herd test) became classed as persistent because of a delay in the farmer confirming adequate cleaning and disinfection (C&D) of premises following removal of reactor cattle. This resulted in statutory cattle movement restrictions remaining in place pending confirmation of completion of C&D and therefore an increase in the incident duration beyond 18 months. The one ongoing persistent incident had originally been disclosed at a 12 month post-incident test in a large dairy herd in 2018. This herd has a long history of previous TB incidents (both OTF-S and OTF-W) and a local wildlife reservoir was considered to be a possible risk pathway for that herd.

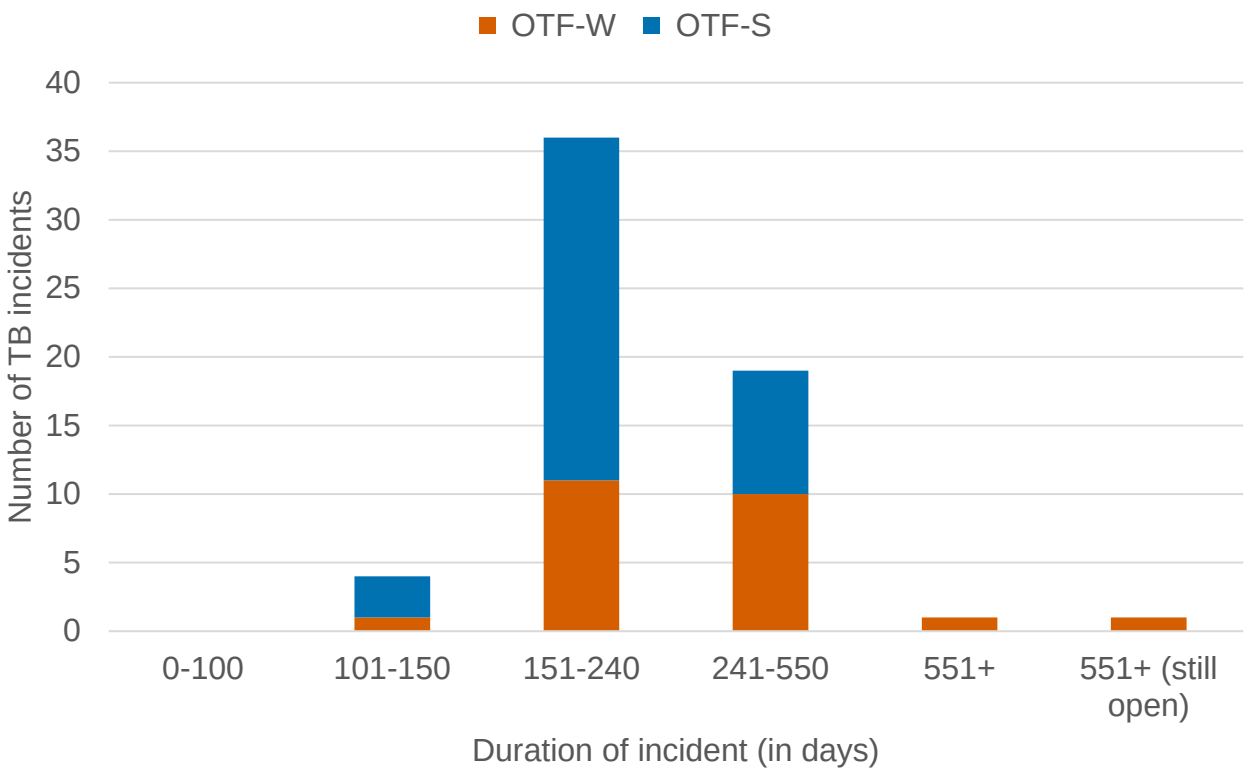

Figure 12: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Leicestershire. Note that Approved Finishing Units (AFUs) have been excluded.

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 Leicestershire are as follows:

- Infected wildlife
- Movements of undisclosed infected cattle

Sources of infection and risk pathways

The summary of the weighted sources of infection for all TB incidents starting in 2019 in Leicestershire is shown in Figure 13a, Figure 13b and in Appendix 4.

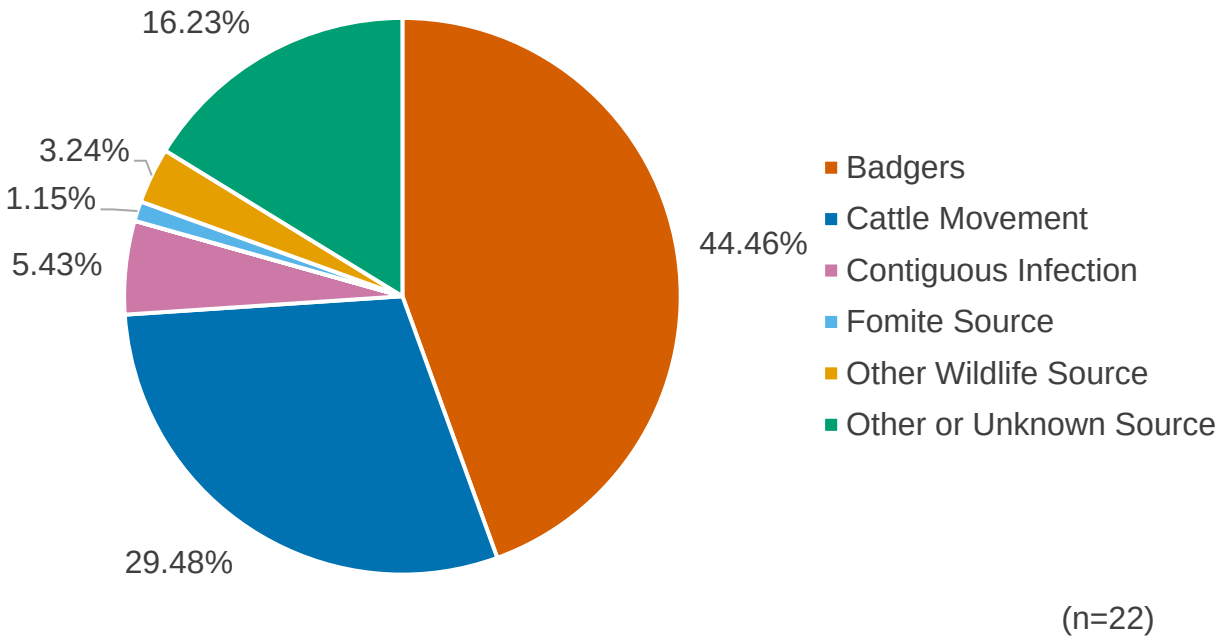

Figure 13a: Summary of the weighted source of infection pathways attributed for all OTF-W incidents in Northamptonshire that started in 2019, that had a completed DRF (22).

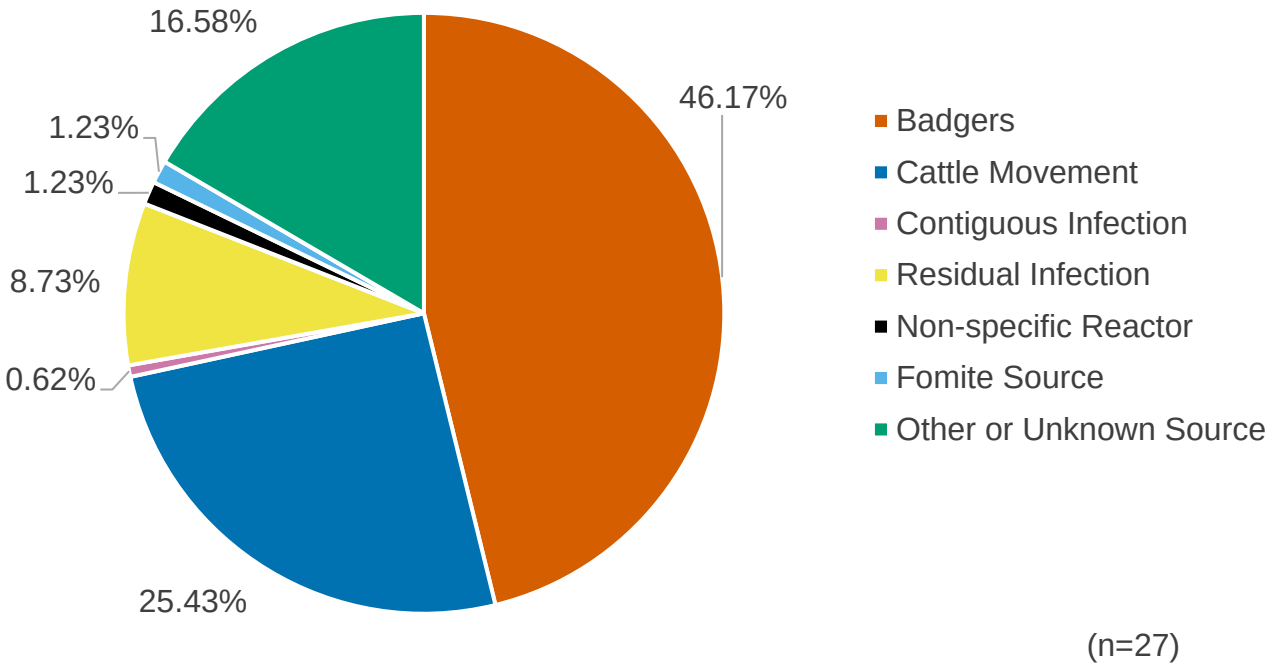

Figure 13b: Summary of the weighted source of infection pathways attributed for all OTF-S incidents in Northamptonshire that started in 2019, that had a completed DRF (27).

Possible wildlife infection accounted for 45% of the weighted contribution of all the potential risk pathways of infection for herds with new TB incidents reported in 2019, compared to 50% in the previous year. This reduction is due in part to an improved methodology in calculations of the contribution of the different pathways.

There has been an increase in the number incidents in which badger infection was considered to be most likely in north-east Leicestershire as previously shown in Figure 8. Some areas in this part of Leicestershire are now considered endemic with genotype 25:a, including the potential TB hotspot area HS23, where the TB status of wildlife (badgers and wild deer) is being monitored.

Badgers are deemed to be the main wildlife source of infection, whilst deer are thought to play a minor role in transmitting infection. There is limited data available from wildlife surveillance and a subsequent lack of more accurate information on the real infection levels in wildlife. This must be considered when assessing risk pathways for infection in TB incidents where wildlife is assessed as possible source of infection and cannot be ruled out although the potential involvement is associated with uncertainty.

Cattle movements accounted for almost 30% of the weighted contribution of all risk pathways in 2019, similar to the previous year. This is the second most important driver of the TB epidemic in Leicestershire.

Bringing animals into a herd will always carry a risk of introducing disease although restocking is important for the cattle industry as part of their business model, as well as the need to restock after

the removal of TB reactors. It is becoming increasingly difficult for farmers to locally source cattle from holdings with no TB history. The Defra funded TB Advisory Service (TBAS, www.tbas.org.uk/) and other tools available for farmers such as ibTB database (www.ibtb.co.uk) encourage farmers to safely source cattle.

In 2018, 5% of all weighted risk pathways were of unknown source compared to a 16.5% weighted contribution in 2019. This is due mainly to the improved methodology to calculate the contribution of the different pathways with more accuracy. The 'unknown source' category also accounts for low certainty risk pathways.

The increase in the number of incidents with undetermined sources may also be due to incidents having not yet resolved and insufficient data being available.

The source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in the county by herd type is shown in Figure 14.

- Beef fattener sector: 14 TB incidents occurred in this sector in 2019, of which 21% (three) have been associated with wildlife. This is an increase from 2018 as only 10% (one) of all incidents in this sector were considered to be of wildlife origin. There has been a decrease in the number of incidents associated with cattle movements in this sector, from 80% (eight) in 2018 to 21% (three) in 2019.
- Beef suckler sector: 13 TB incidents occurred in this sector in 2019, of which over 60% were attributed to infection via contact with wildlife, the same as in 2018. There has been an increase in the number of TB incidents associated with the movement of cattle in 2019, with over 30% (four) of all cases in this sector in comparison to 11% (two) of all cases in 2018.
- Dairy sector: 23 TB incidents occurred in this sector, of which 43% (ten) were considered to be of wildlife origin compared to 82% (13) in 2018. There has been an increase in the total number of incidents in dairy herds in the year (from 16 in 2018 to 23 in 2019). There has also been an increase in TB incidents associated with the movement of cattle, with over 21% (five) of all cases in this sector in comparison to 6% (one) in 2018.

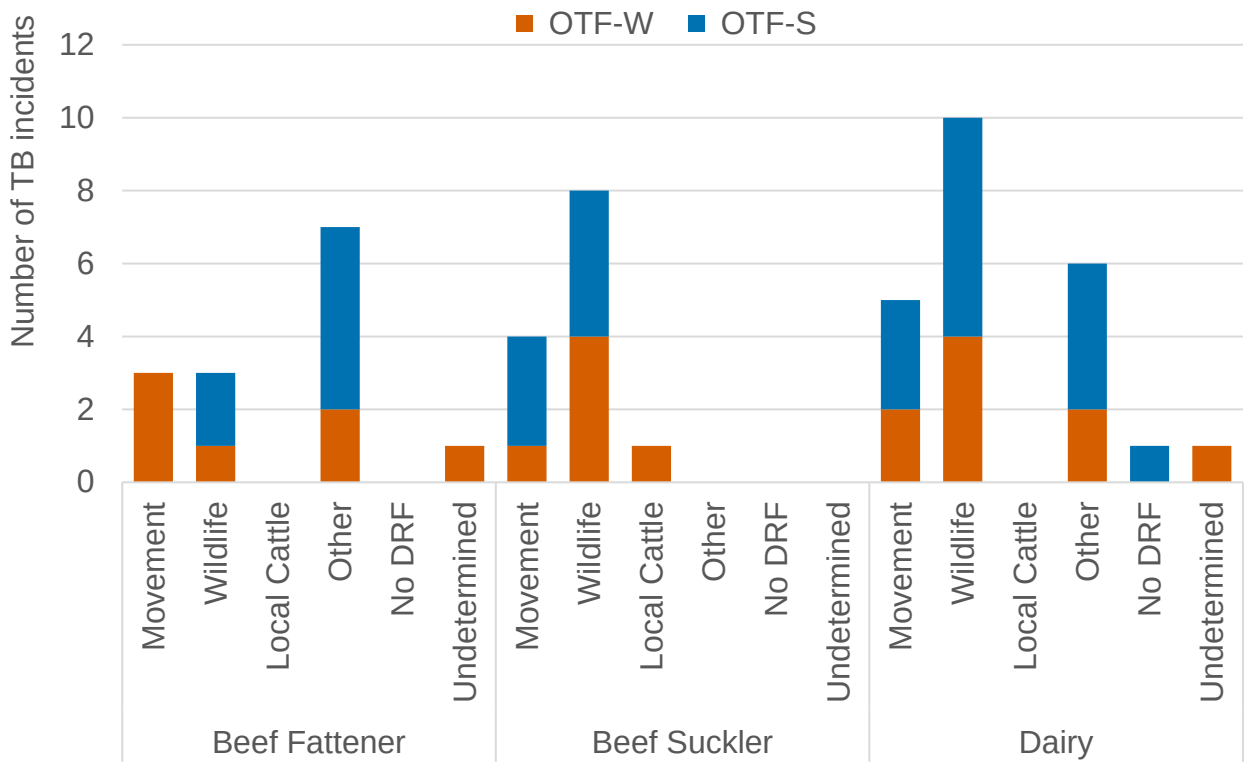

Figure 14: Source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in Leicestershire in 2019, by herd type. Note that the categories 'movement', 'wildlife', and 'local cattle' are comprised of incidents where these were the most likely single source 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 other species, including domestic non-bovine farm animals (camelids, goats, sheep and pigs) in Leicestershire in 2019. Submission rates are extremely low in other domestic species.

Detection of incidents

In Leicestershire during 2019, 42% of new TB incidents were disclosed by routine annual surveillance testing of herds, similar to 2018 (Figure 15). This was closely followed by radial surveillance tests. Only 6% of incidents were initiated by passive surveillance through routine post mortem meat inspection of non-reactor cattle in the slaughterhouse. This could be an indication of improved and more frequent TB skin testing leading to earlier detection of disease within a herd with consequently fewer incidents being identified by passive surveillance in the slaughterhouse.

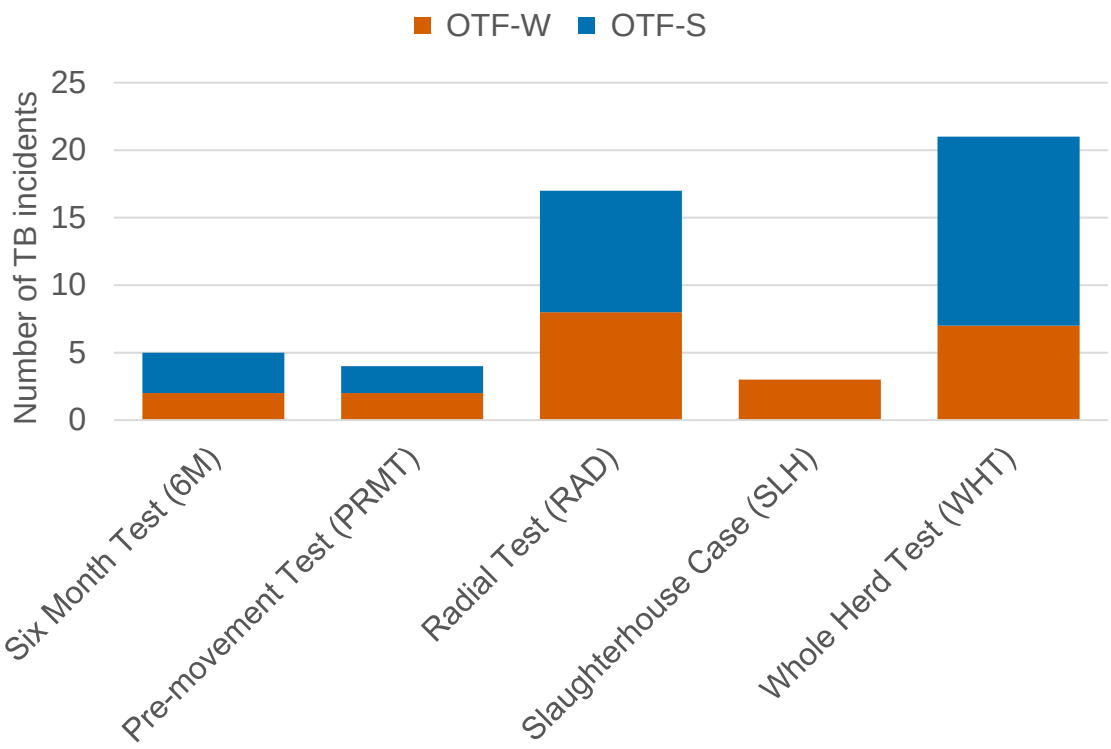

Figure 15: Number of TB incidents (OTF-W and OTF-S) in Leicestershire in 2019, disclosed by different surveillance methods.

Radial testing (RAD) was rolled out in 2018 in Leicestershire. In 2019, 17 of the 50 TB incidents were disclosed by this surveillance testing method. This accounted for 34% of all incidents in 2019 compared to 15% in 2018. This emphasises the importance of enhanced, targeted surveillance testing.

Six month testing (6M), carried out six months after a herd regains OTF status following resolution of an incident, disclosed 10% of all incidents in 2019. Herds can suffer a recurrence of infection soon after the end of an incident for a number of reasons, such as continual reinfection from wildlife, introduction of undetected infected cattle in the herd, or a failure to detect all infected cattle during the previous incident, resulting in residual infection being left in the herd.

The majority of herds with a new TB incident in 2019 had not experienced TB infection in recent years. Approximately 25% of both OTF-S and OTF-W incident herds had suffered TB incident in the previous three years (Figure 16). Many of the farmers with TB incidents in 2018 followed APHA recommendations to utilise the TB Advisory Service, which offers free bespoke on-farm visits and advice about TB and biosecurity. This has encouraged greater awareness of TB infection risk and prevention. As a result there may have been better preventive measures in place on those farms with a recent history of TB resulting in the majority of new TB incidents in 2019 occurring in herds which did not have a history of recent TB infection.

Herds with repeat infections could be experiencing reinfection or residual infection from a previous incident. In the case of OTF-W incidents, the compulsory application of the supplementary IFN-γ blood test in certain TB incident herds results in increased test sensitivity and the risk of leaving false

negative animals on the affected farm is reduced. Reinfection could be attributed to the fact that endemicity is increasing in north-east Leicestershire.

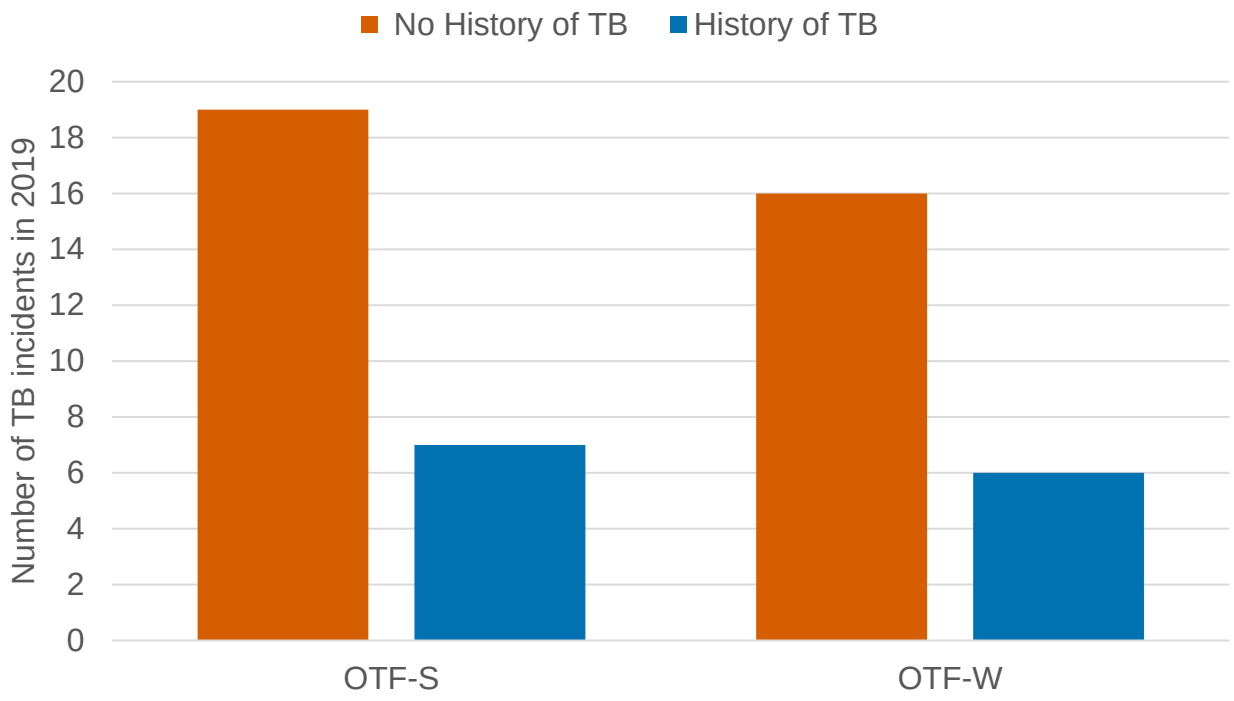

Figure 16: Number of TB incidents (OTF-W and OTF-S) in Leicestershire in 2019 on holdings that have suffered an OTF-W incident in the previous three years, and holdings with no history of TB in the previous three years.

Skin test reactors removed and interferon gamma test positive animals removed

The financial burden to the tax payer and farmers of TB in Leicestershire is significant in terms of the number of incidents and the number of cattle being slaughtered. Tax payers' money is predominantly spent on TB tests and financial compensation for reactor compulsorily removed for slaughter.

The cost to the farmers is the impact on the ability to move cattle off the incident premises which can have considerable consequences for breeding stock (bulls, cows and heifers), for weaned beef calves, stores and for dairy calves not normally reared on farm. Likewise, replacing stock following slaughter of reactors can prove difficult, particularly in the case of pedigree or organic herds and in herds where large numbers of reactors were identified at the disclosing test (when no stock is allowed to move on before the first incident test has been completed). TB incidents of longer duration undergo more testing, with the removal of additional reactors. The longer the restrictions are in place, the greater the cost to individual farmers and to the tax payer

As shown in Figure 17, in 2019 a total of 512 reactors were removed, which equates to 111 more cattle than in the previous reporting year. In 2019, 60% of the reactors removed were IFN-γ test positive animals. This is higher than in 2018 when less than 50% of all reactors were IFN-γ reactors.

There has been an increase in number of reactors detected per incident as shown in Table A3.2. In 2019 there were 10.2 reactors detected per incident compared with 6.8 in 2018. Overall this reporting year there has been 2.7 reactors per 1,000 animals tests compared to 2.2 in 2018.

The IFN-γ test has a higher sensitivity than the skin test and so, when applied in parallel with the skin test, will disclose more infected cattle, often at an earlier stage; this can reduce the duration of an incident and minimise spread both within and from the herd. Despite the reduction in the number of TB incidents from 59 in 2018 to 50 in 2019, there has been a significant increase in the number of reactors removed. This increase may have resulted from longer incident durations, more reactors per incident and possibly larger herds affected.

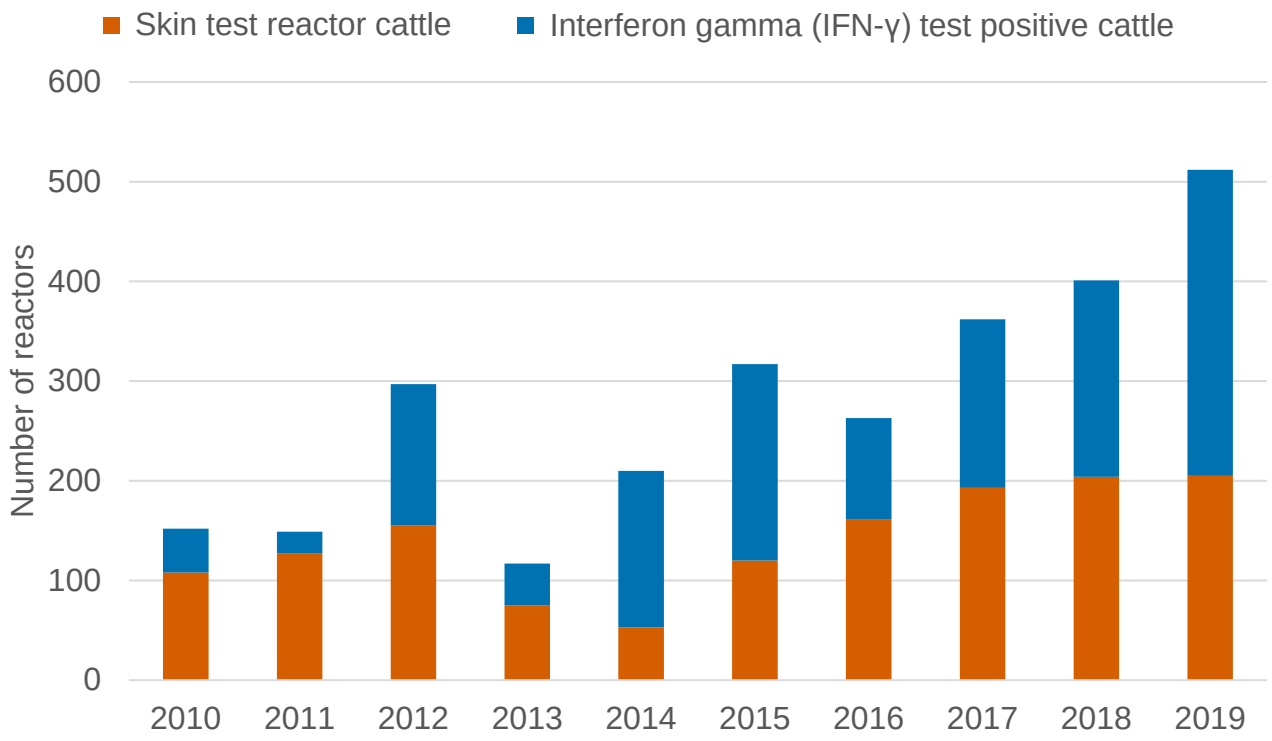

Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Leicestershire, 2010 to 2019.

Summary of risks to Leicestershire

There are two main risks of introducing TB into Leicestershire: movement of undetected infected cattle from herds in other Edge Area counties and the HRA and lateral spread from neighbouring counties as described below.

Other counties adjacent to Leicestershire are the Edge area counties of Nottinghamshire, Northamptonshire, Warwickshire and Derbyshire.

In 2019 there have been no incidents on the boundary with Nottinghamshire hence this county doesn't pose a major risk to Leicestershire at present. In 2018 there were several TB OTF-W cases in Nottinghamshire in very close proximity to the north-east of Leicestershire.

Several OTF-W incidents associated with wildlife have been identified in the neighbouring counties and could pose a risk to Leicestershire. These incidents are in north-east Warwickshire and north Northamptonshire; both counties have a higher TB incidence than Leicestershire.

There have been three TB incidents in north Northamptonshire in close proximity to the Leicestershire border. Two of the incidents were OTF-W, and one was likely to be of wildlife origin.

There were cases attributed to wildlife reservoirs of infection in north-east Warwickshire on the border with Leicestershire. There are indications that disease is becoming endemic in this area and this poses a risk to south-west Leicestershire.

For the third consecutive year, there have not been any TB incidents in Derbyshire near the border with Leicestershire.

The greatest risk of spread of infection is in the two areas bordering the counties of Warwickshire and Northamptonshire, particularly since cattle density is high in these two areas.

Summary of risks from Leicestershire to the surrounding areas

The summary of risks to the LRA and South of Nottinghamshire is unchanged from those detailed in the 2018 report. Specifically, the north-east Leicestershire cluster continues to be of concern because of its persistence and contiguity to the LRA of Lincolnshire, and that overspill of disease into wildlife has potentially serious consequences.

Genotype 25:a of *M. bovis* has been identified in several TB incidents in this cluster spanning the south of Nottinghamshire and the neighbouring Lincolnshire parishes. The majority of these cases are associated with wildlife infection.

The Whole Genome Sequences (WGS) of the *M. bovis* isolates obtained from these cases are being determined in order to further investigate and define the possible transmission pathways. This should help to assess the need for more specific and targeted surveillance and control measures in this area.

APHA epidemiological investigations carried out in 2018 in north-east Leicestershire contributed to the establishment later that year of a new potential TB hotspot area straddling north-east Leicestershire (Edge Area) and west Lincolnshire (LRA). This area (HS23) is where potential TB hotspot procedures have been in force, including enhanced levels of surveillance in cattle and wildlife (badgers and wild deer). A potential TB hotspot area is identified when one or more lesion and/or culture positive TB incidents of obscure origin occurs in the Low Risk Area. Obscure origin means that, following investigation by APHA, the incident cannot be attributed to the introduction of TB-

infected cattle or to spread from other cattle herds or non-bovine livestock in the locality. Potential hotspot areas are normally defined by distinct boundaries such as rivers or roads to facilitate identification of whether wildlife found dead are eligible for inclusion in the wildlife survey.

During 2019, 17 badgers and one deer were reported to APHA as part of the wildlife surveillance in HS23. Of these, 13 badgers and one deer were suitable for collection by APHA staff. Two of the badgers collected were not suitable for post-mortem examination, resulting in 11 badgers and one deer being examined. Of these, two badgers had visible lesions consistent with TB. Further bacteriological culture of the lesions was undertaken with results becoming available in 2020 (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/914655/tb-surveillance-in-wildlife-sept2020.pdf).

Assessment of effectiveness of controls and forward look

Further active surveillance of wildlife in the north-east and south-west of the county would support the assessment of the extent of wildlife involvement in bovine TB spread. The epidemiological investigations carried out on farms can only make assumptions when new TB incidents are attributed to wildlife infection and this will need to be confirmed by post-mortem examination and sampling of wildlife.

Parallel IFN-γ testing has been useful in identifying additional infected cattle earlier in herds sustaining OTF-W incidents in the Edge Area. This has been effective in reducing within-herd and herd-to herd spread of TB, but other measures are still required to address the sources and pathways of infection to prevent recurrence or introduction of new infection once testing and slaughter has removed disease.

The application of appropriate measures to control TB infection in badgers in some areas of Leicestershire is necessary to complement these enhanced measures and enable removal of as much infection as possible. The Badger Edge Vaccination Scheme (BEVS) has been ongoing in areas of Leicestershire and may support the buffering of areas of low disease incidence from pockets of endemic TB. It is unlikely that an immediate effect will be observed for any of these measures and it is more likely that it will take a further two or three years before benefits become evident.

It is difficult to provide an opinion on the course of the epidemic over the next two years, partly due to the cyclical component of the TB epidemic and partly because of its multifactorial nature and the constantly evolving control policy, whose assessment overtime is very complex (for the reasons mentioned) and can only be done retrospectively.

The epidemic appears to be established in areas of Leicestershire, with some worrying signs, mainly the suspicion that wildlife reservoirs in the north-east of the county could be playing a bigger part than previously thought in the spread and persistence of the disease locally.

Appendices

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

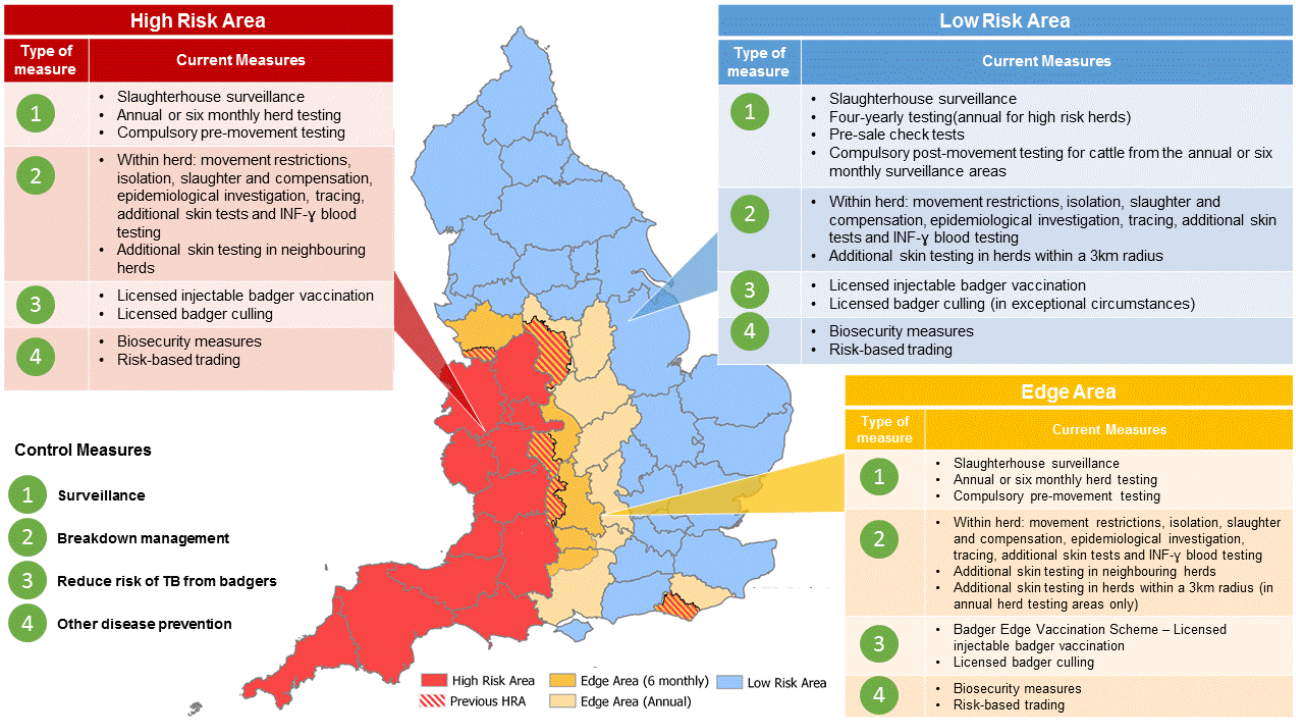

Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Bovine Tuberculosis Free status for England. Map based on information published on www.tbhub.co.uk.

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 Leicestershire

Edge Area testing policy:
Radial testing of herds in a 3km radius around an OTF-W incident holding continues in the whole county, along with annual surveillance testing.

Mandatory IFN-γ blood testing continues to apply in all new OTF-W incidents. Exemptions are applied on rare occasions, 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.

All Inconclusive Reactors (IRs) that have a negative result on re-testing remain restricted for the rest of their life to the holding in which they were found. Such animals can only move to a slaughterhouse or Approved Finishing Unit (AFU). To release resolved IRs in OTF herds from life-long restrictions, the option of private IFN-γ blood testing is available to cattle keepers, subject to securing prior approval from APHA.

Other testing measures:
Discretionary exemptions from annual routine surveillance whole herd testing have been 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 of those delayed tests having had any notable impact on the epidemiology of TB in Leicestershire during 2019.

Other control measures:
TB Advisory Service (TBAS, www.tbas.org.uk/) is providing farmers with free biosecurity advice visits.

Official Veterinarian (OV) TB skin testing quality control audits continue to be carried out by APHA in parallel with those being completed by the Veterinary Delivery Partners who are contracted to provide the statutory TB skin testing on behalf of APHA.

APHA liaises with Local Authorities as necessary, especially regarding the enforcement of overdue TB tests, illegal movements, suspicions of fraudulent generation of skin test reactors, and with Public Health England regarding cases of pulmonary TB in cattle or the consumption of unpasteurised milk on farms affected by OTF-W incidents.

Badger vaccination project: The four-year projects which Defra funded under the original Badger Edge Vaccination Scheme (BEVS) which started in 2015 were terminated in 2016 because of a world-wide shortage of BCG vaccine. One of those projects was run by Nottinghamshire Wildlife Trust (NWT) on the Nottinghamshire/Leicestershire border. A new scheme – BEVS2 – was launched at the end of 2018 and an expanded version of the previous NWT project was approved and started in May 2018.The 8,310 ha (83.1 km^2) project covers areas of south Nottinghamshire and north Leicestershire.

Appendix 2: cattle industry in Leicestershire

Table A2.1: Number of cattle premises by size band in Leicestershire 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	7	402	158	160	75	41	47	890	131	61

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of Cattle	72,127 (61%)	40,837 (34%)	4033 (3%)	8 (<1%)	117,005

Appendix 3: summary of headline cattle TB statistics

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

Herd-level statistics	2017	2018	2019
(a) Total number of cattle herds live on Sam at the end of the reporting period	1078	1048	1043
(b) Total number of whole herd skin tests carried out at any time in the period	1038	1181	1208
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	906	885	847
(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)	1013	971	974
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	1049	1009	1014
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	46	59	50
• OTF-S	25	37	28
• OTF-W	21	22	22
(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?	7	11	7
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	18	18	9

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.)	0	2	10
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	2	2	3
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	N/A	9	17
• OTF-S	N/A	6	9
• OTF-W	N/A	3	8
(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)	13	16	15
(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	12	13	14
• Exempt Finishing Units: Grazing	0	0	0
• Exempt Finishing Units: Non Grazing	0	0	0

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)	150,622	179,171	189,217
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	193	204	205
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	169	197	307
(c) Reactors detected during year per incidents disclosed during year *	7.9	6.8	10.2
(d) Reactors per 1000 animal tests	2.4	2.2	2.7
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	15	0	10
• Private slaughters	16	54	22
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	16	10	20
(g) SLH cases confirmed by culture of *M. bovis* **	6	4	8

* 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 2019.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	16	6	18	1	45.4%
Cattle movements	15	2	6	5	27.3%
Contiguous	1	1	1	0	2.8%
Residual infection	0	0	3	0	4.8%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	2	0	0	0	0.7%
Fomites	4	0	0	0	1.2%
Other wildlife	2	1	0	0	1.5%
Other or unknown source	2	1	3	0	16.4%

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

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