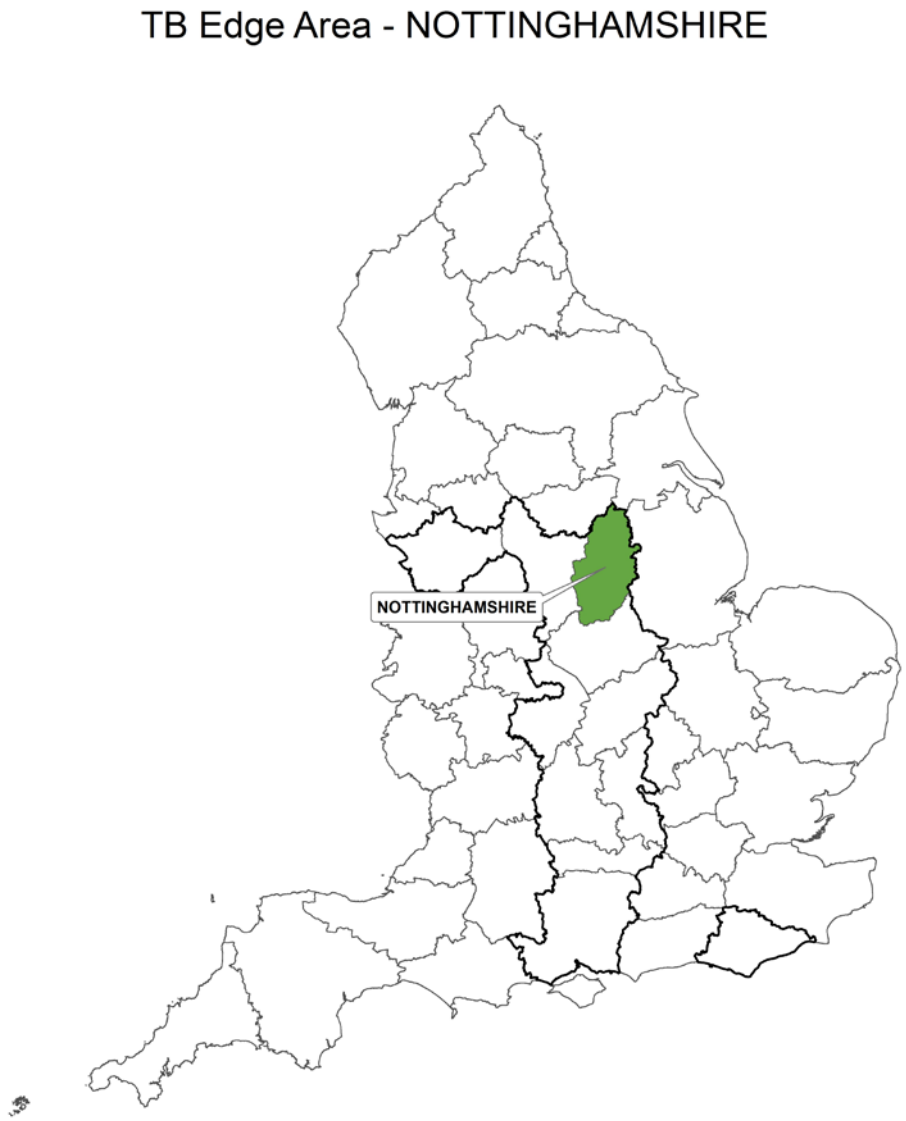
Animal & Plant Health Agency

Year-end descriptive epidemiology report:

Bovine TB in the Edge Area of England

County: Nottinghamshire

Year-end report for: 2019



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Executive summary

Reporting area

Nottinghamshire 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 Nottinghamshire.

Local cattle industry

No significant changes in 2019. There is a predominance of small herds of up to 50 cattle in the county, the majority of which are beef cattle. A significant arable industry is supportive of units finishing beef stock.

New incidents of TB

The number of new incidents disclosed in 2019 (14) represents a decrease from 2018 (17) and it is close to the number of incidents disclosed in 2017 (13), which was the year with the fewest new incidents since 2013. The annual number of incidents remains relatively stable, although with a possible slightly decreasing trend.

Suspected sources and risk pathways for TB infection

The weighted contribution of movements of undetected infected cattle represented 27.4% of the suspected source pathways of incidents in 2019, while wildlife-related infection represented 9.5%. The weight of contribution of undetermined sources was 57.1% in 2019, mainly due to OTF-S incidents.

These figures are significantly different from 2018, in which the weight of source pathways potentially attributed to wildlife reservoir was 40%. This reduction is due to several factors: a lower number of cases in which possible wildlife infection was suspected, a more precise definition of possible pathways in undetermined incidents, and the aforementioned improved methodology.

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

Routine whole herd tests disclosed 71% (ten) of new incidents. This group represented the most important surveillance stream for detection of new cases. Radial testing (targeted surveillance of herds located within a 3km radius of a herd with an OTF-W incident) was introduced in 2018 as a compulsory measure in Nottinghamshire, contributing to detection of 7% (one) of the new incidents. Passive slaughterhouse surveillance detected 21% (three) of incidents which contributed to three of the five OTF-W incidents.

Reactor numbers

77 cattle were compulsorily slaughtered for TB control purposes in 2019, which is very similar to 2018 (81). Of those, 36 animals were detected by interferon-gamma (IFN-γ) blood tests and 41 were skin test reactors.

For new incidents disclosed in 2019, the low number of test reactors per incident, the relatively short duration of those incidents, and low annual prevalence point to early detection of disease in Nottinghamshire and low probability of spread.

Risks to the reporting area

There is no HRA adjacent to Nottinghamshire. The main risk from the HRA is the purchase of cattle from HRA farms, particularly for finishing units which are widespread throughout the county.

Hot Spot 23 (HS23): One potential hotspot area (HS23) has been active since June 2018 near Grantham in the south-west of Lincolnshire and straddling north-east Leicestershire. By the end of 2019, enhanced wildlife surveillance had identified two badger carcases with visible lesions consistent with TB. Further bacteriological culture of the lesions was undertaken with results becoming available in 2020. This is clearly an area of concern, although there was no evidence of spread of infection into Nottinghamshire in 2019.

There was no evidence of spread of infection from Derbyshire (Edge Area) eastward into Nottinghamshire.

Risks posed by the reporting area

There is a risk of importing TB into fattening units from HRA farms, which could spread into adjacent areas. However, the data contained in this report suggests that this risk is promptly identified with the current TB testing of cattle herds and mitigated with the increasing numbers of Approved Finishing Units in Nottinghamshire.

There is a potential risk both to Nottinghamshire and neighbouring counties, particularly in the south near the Leicestershire border, from infected wildlife, but as there is limited wildlife surveillance in the area it is difficult to draw conclusions.

Forward look

Historically Nottinghamshire has had low levels of TB, with purchases of undetected infected animals from the HRA primarily for fattening as the main risk identified.

The TB situation in Nottinghamshire appears stable currently, with 2019 surveillance data indicating a slight improvement from 2018 data. The objective to reduce OTF-W herd incidence to <1% by 2025 appears achievable if this positive trend is maintained, but it will depend on the control of disease in wildlife in nearby endemic areas, and the better understanding of current disease levels in wildlife in lower incidence areas, to enable control measures to be implemented according to the risk.

Introduction

This report describes the level of bovine tuberculosis in cattle herds in Nottinghamshire 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 Nottinghamshire, 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). Nottinghamshire 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 Nottinghamshire. 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 Nottinghamshire and all the other parts of the Edge Area that remained on annual testing.

Cattle industry

Herd types

The predominant cattle farm type in Nottinghamshire are small herds of up to 50 cattle (55% of all herds) as shown in Figure 1, and it is reasonable to assume that the majority of these are beef cattle.

There is a predominance of beef cattle (66% of total cattle in Nottinghamshire), including both suckler and finishing herds. There is a significant arable industry in this county which is supportive of units which choose to finish homebred or purchased stock, while several suckler herds still choose to sell their calves as stores through the local markets.

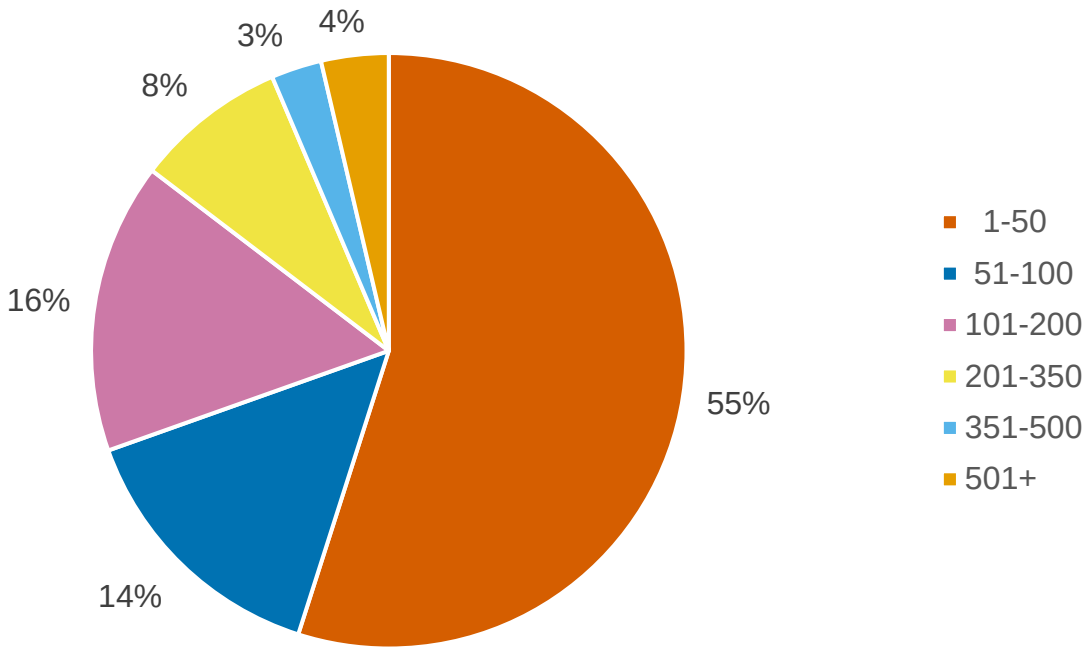

Figure 1: Proportion of cattle holdings by herd size in Nottinghamshire in 2019 (n=437).

Markets

In 2019 there was one important livestock market in Nottinghamshire, Newark Livestock Market, which held a weekly sale every Saturday and an Approved Slaughter Gathering (for clear-testing TB restricted cattle).

Approved Finishing Units

In 2019, there were nine Approved Finishing Units (AFU) and one Exempt Finishing Unit (EFU) approved in Nottinghamshire, all non-grazing. The number of AFUs has increased from seven in 2018.

Common land

There is one area of common land in Nottinghamshire (Sutton Holmes) where six cattle herds graze. It was included in radial testing (RAD) procedures following an OTF-W incident in the area. All the RAD tests completed in this area have been negative to date and the radial testing regime is currently ongoing with the last test due by December 2020.

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.

In 2013, the method of setting surveillance TB testing intervals changed from parish to county basis and all cattle herds in Nottinghamshire were placed on annual surveillance testing. This surveillance testing regime has been in place since 2013 and represented an overall increase in testing that is likely to be a factor in accounting for the increased numbers of incidents disclosed, and incidence and prevalence rates that can be observed in Figures 2, 3 and 4.

Figure 2 displays the number of new incidents detected annually in the last ten years (2010-2019) in Nottinghamshire. This figure shows an increase in new incidents disclosed in 2013 (21) and a second peak in 2016 (23). Since 2013, the average annual number of incidents is 17. In this context, the number of total incidents disclosed in 2019 (14) represents a decrease from 2018 (17) and sits close to the lowest annual figure since 2013 which occurred in 2017 (13). The number of OTF-W incidents in 2019 (five) was lower than 2018 but the same as that disclosed in a number of recent years.

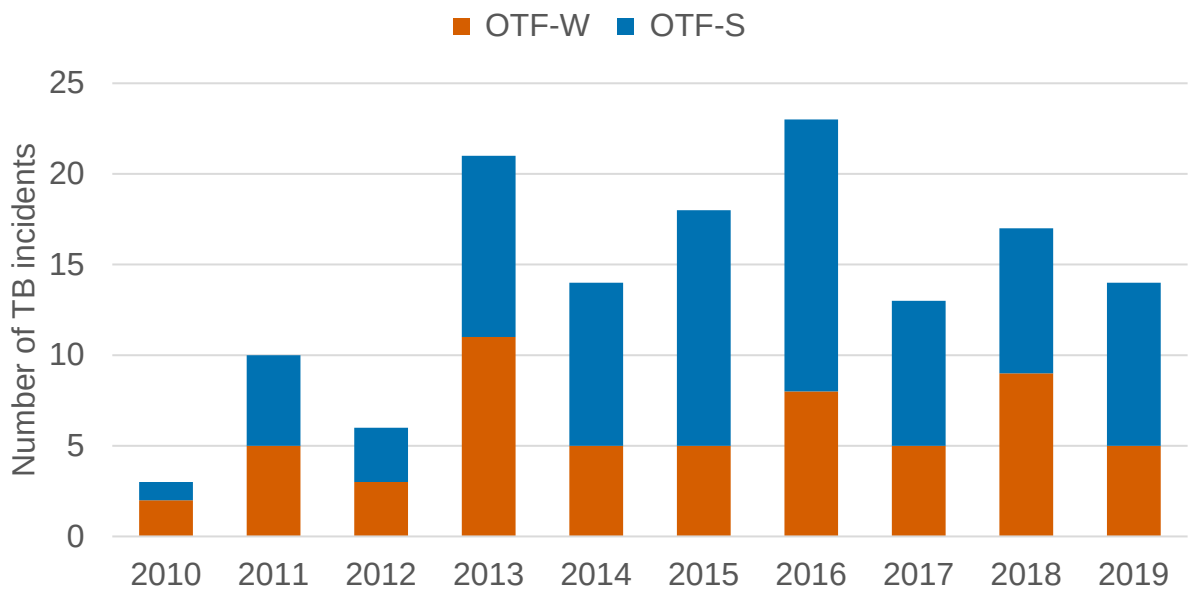

Figure 2: Annual number of new TB incidents in Nottinghamshire, 2010 to 2019.

Figure 3 displays annual incidence rates (incidents per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Nottinghamshire, 2010 to 2019. Since 2013, the average annual incidence rate is 3.5, with a peak in 2016 (4.8). In this context, the annual incidence rate in 2019 (3.4) represents a relative decrease from 2018 (3.9).

Figure 4 displays the annual end of year herd prevalence in Nottinghamshire, 2010 to 2019. Since 2013, the average annual herd prevalence was 1.68%. The annual prevalence rate in 2019 (1.19%) is the lowest since 2013.

An overall look at the total incidents disclosed, incidence and prevalence rates as observed in Figures 2, 3 and 4 appears to indicate that the level of TB in Nottinghamshire is relatively stable.

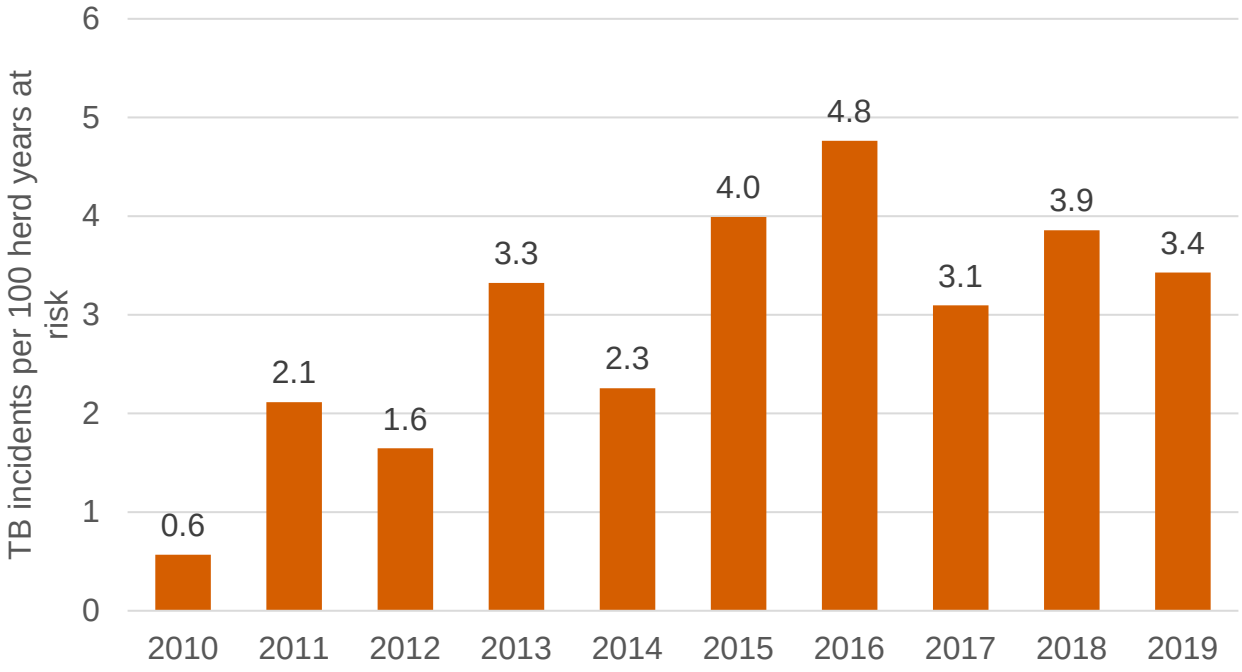

Figure 3: Annual herd incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Nottinghamshire, 2010 to 2019.

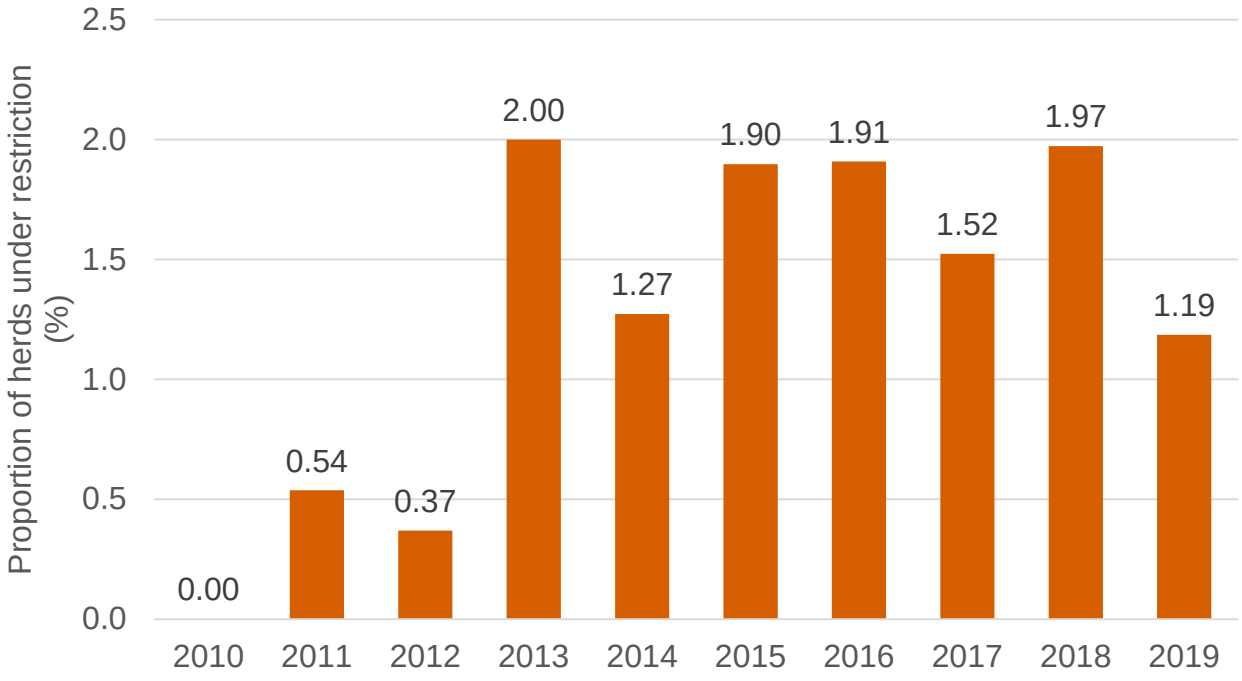

Figure 4: Annual end of year TB herd prevalence in Nottinghamshire, 2010 to 2019.

Geographical distribution of TB incidents

Figure 5 displays the 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 incidence rate in Nottinghamshire in 2019 (3.43) is the lowest of all the Edge counties and it is therefore markedly lower than the average incidence rates of all the Edge Area counties (9.88).

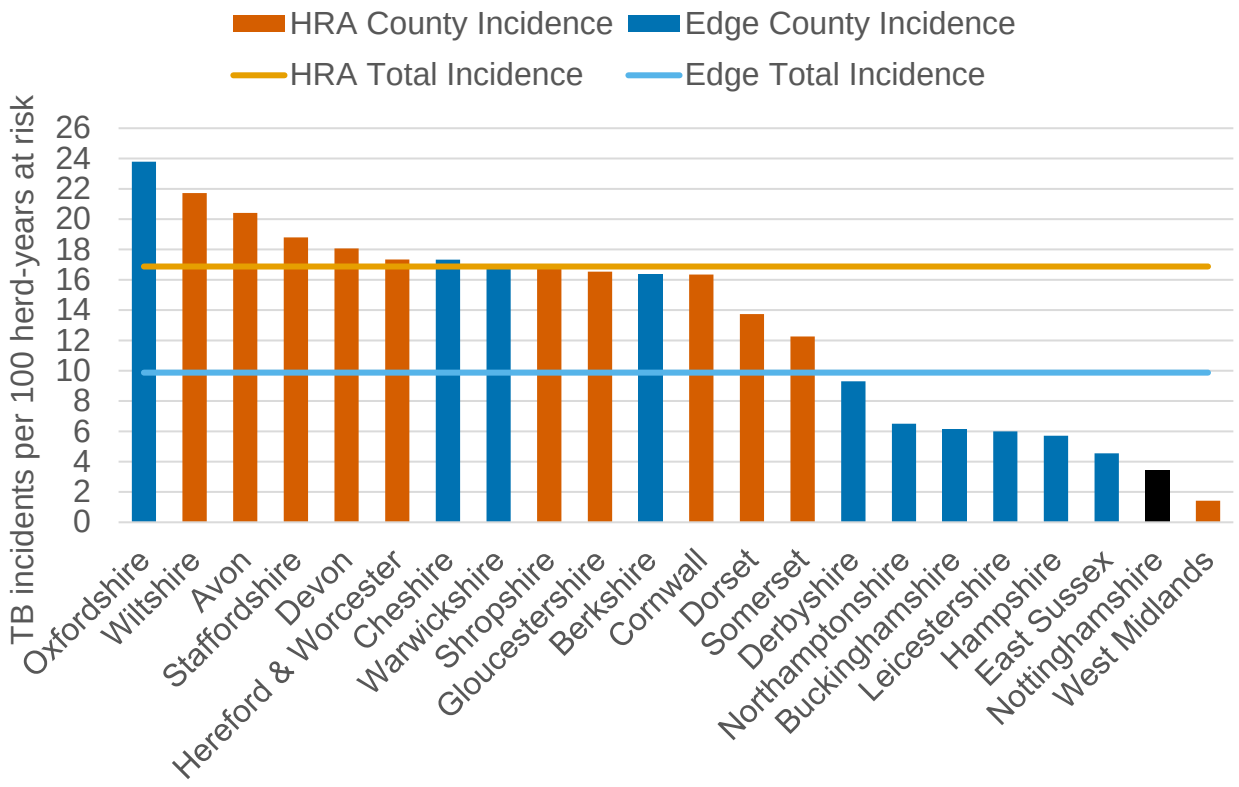

Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in 2019, by HRA and Edge Area County.

Nottinghamshire is located in the north-east of the Edge Area, bordering two other Edge Area counties (Derbyshire and Leicestershire) and Low Risk Area counties (Lincolnshire, South Yorkshire and Humberside).

As observed in Figure 6, the geographical distribution of TB incidents in Nottinghamshire tends to follow the areas of higher cattle herd densities, mostly in the south of the county, although there are five OTF-S incidents clustered in the north-east of the county. There are no significant changes in the geographical distribution from previous years.

The geographical distribution of TB incidents (OTF-W only) in which a wildlife source was attributed with a 75% certainty or above, as an indication of endemicity within local wildlife in 2018 and 2019 is displayed in Figure 7. The map shows a single incident in Nottinghamshire, disclosed in 2018 and in which genotype 10:a was identified. In recent

years, several genotype 10:a incidents have been disclosed in this area in south Nottinghamshire and the possibility that these could be related to local wildlife infection is being investigated further. There is currently no evidence of this genotype being present in local wildlife but there is very little wildlife surveillance data available in this area.

The map also displays an area in north-east Leicestershire with a cluster of OTF-W incidents with genotype 25:a which appear to be related to endemic disease. There was no evidence of spread of endemic disease from this cluster into Nottinghamshire in 2019.

Figure 8 displays three TB incidents in red, which were all highly likely to have been related to purchases of infected cattle. These three incidents were OTF-W, two identified with genotype 25:a and one with genotype 17:a

The sources of the remaining TB incidents in 2019 (two OTF-W and nine OTF-S) were undetermined. Genotype 10:a was identified in one of two undetermined OTF-W incidents and was located in south Nottinghamshire. It is being investigated as part of a group of genotype 10:a incidents of undetermined origin disclosed in this area and, as mentioned before, although there is no evidence of this genotype being present in local wildlife there is very little wildlife surveillance data.

The remaining undetermined OTF-W incident (genotype 35:a identified) was located in west Nottinghamshire. There are no other recent local incidents with this genotype, either in Nottinghamshire or in nearby Derbyshire.

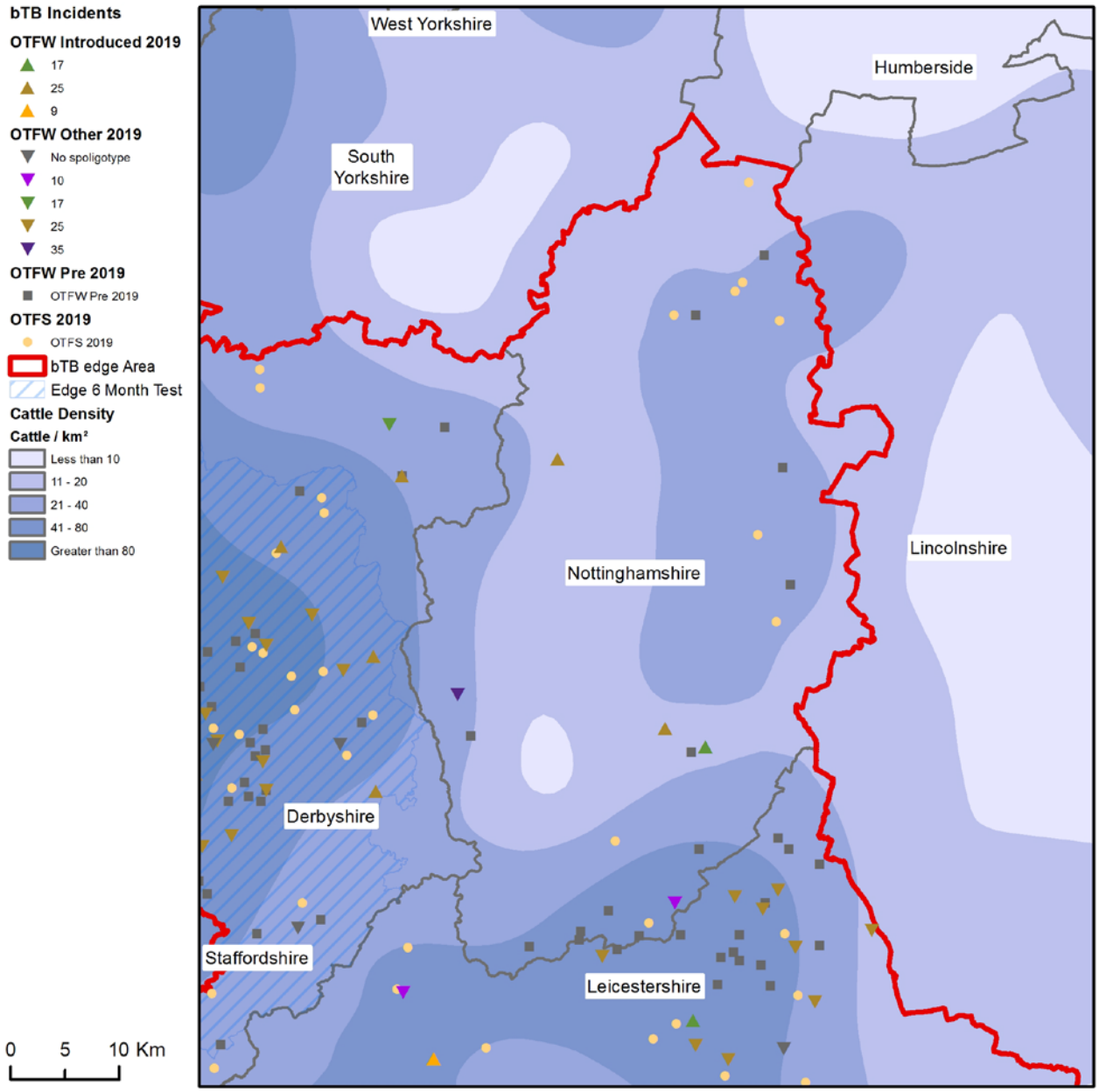

Figure 6: Location of cattle holdings in Nottinghamshire with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the beginning of 2019, overlaid on a cattle density map. To note, 'OTF-W Introduced 2019' refers to OTF-W incidents in which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

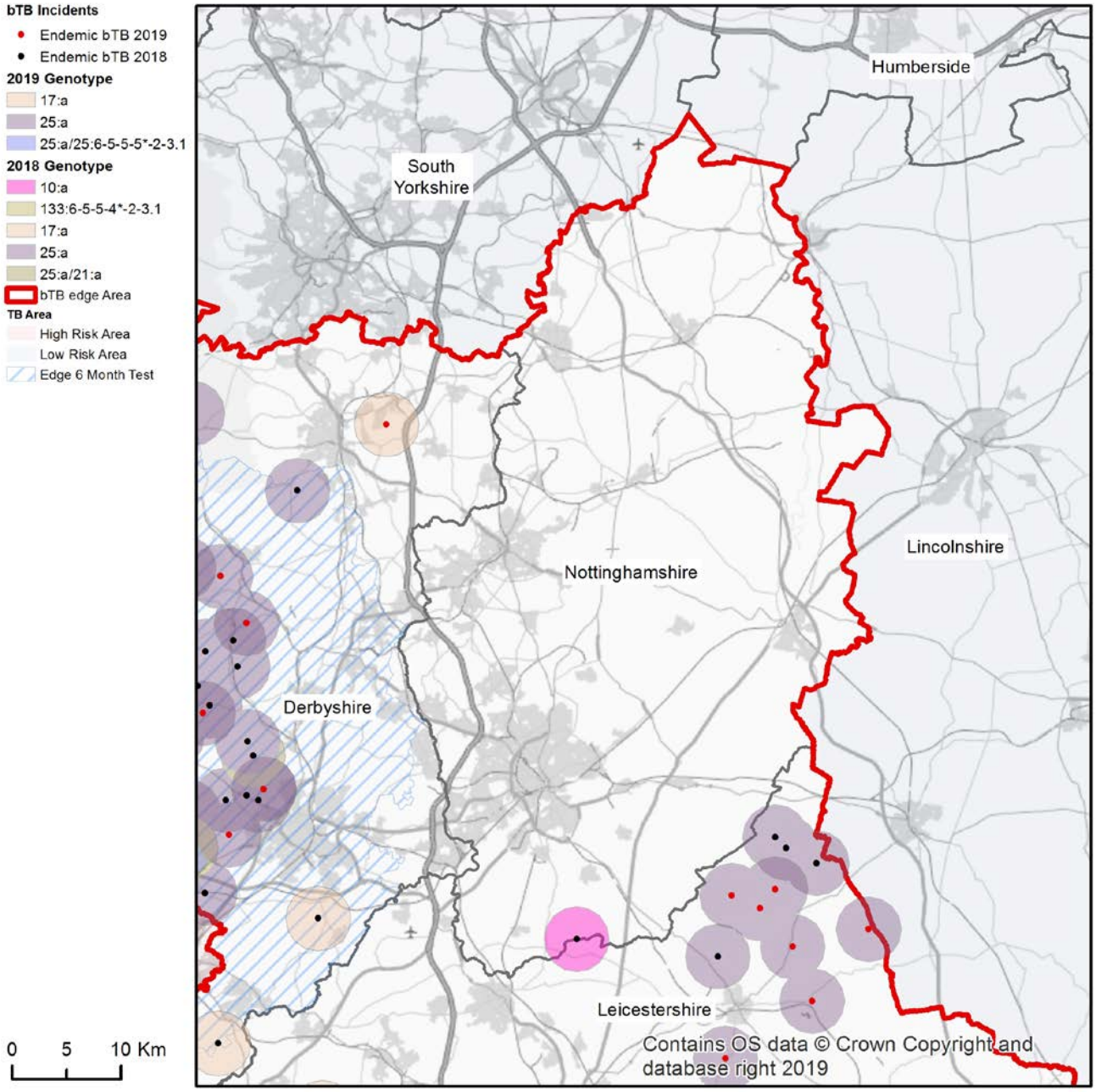

Figure 7: Genotypes of *M. bovis* detected in Nottinghamshire in 2018 and 2019, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemic infection within local wildlife populations (OTF-W incidents only).

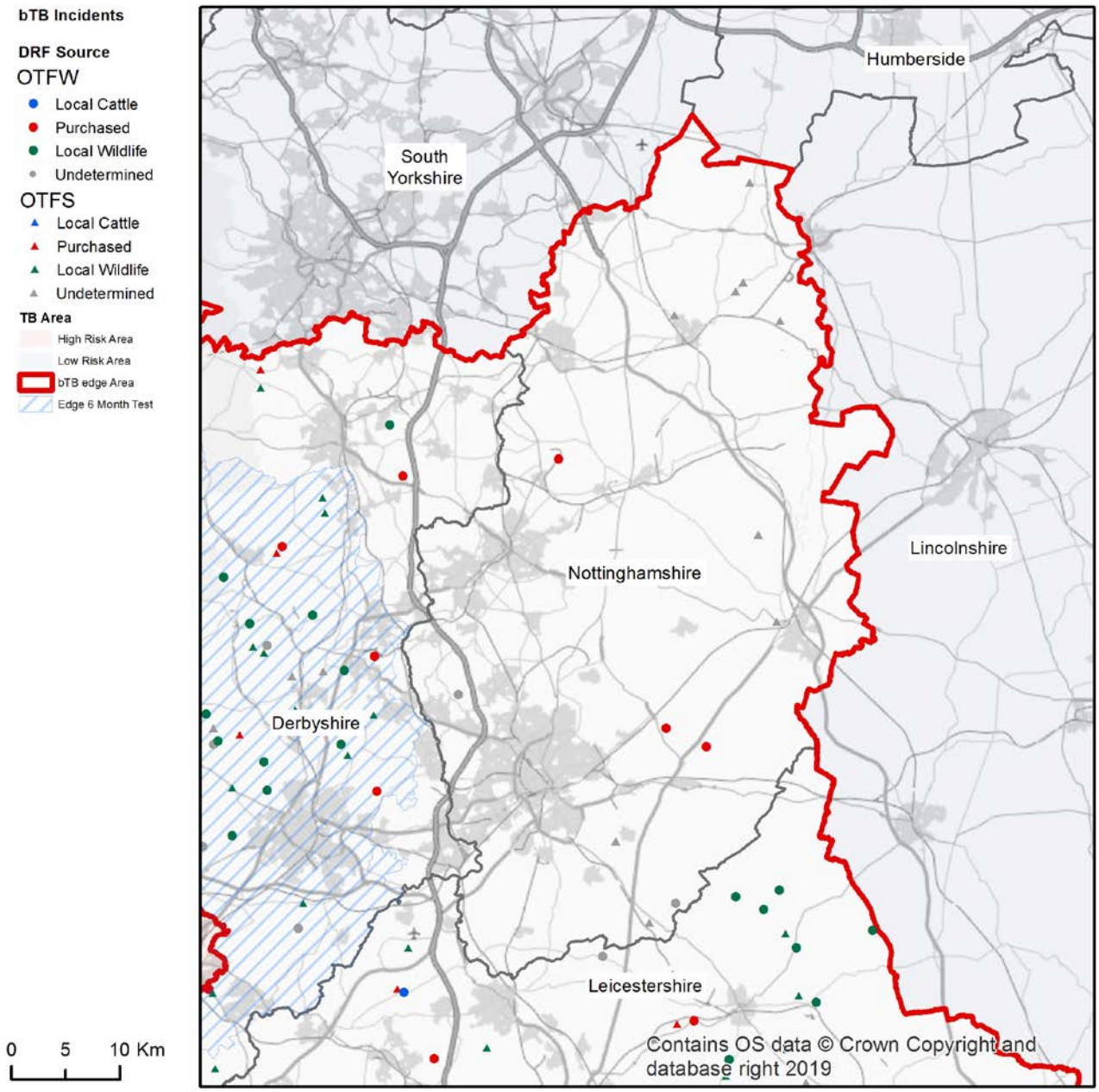

Figure 8: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Nottinghamshire, and its adjoining Edge Area counties, which started in 2019.

Other characteristics of TB incidents

Incidents by herd types

The distribution of incidents by cattle herd size (Figure 9) mirrors the distribution of cattle herds (Figure 1), with nine of the incidents in 2019 out of the total 14 (64%) disclosed in herds with fewer than 100 cattle (69% of the total of cattle herds).

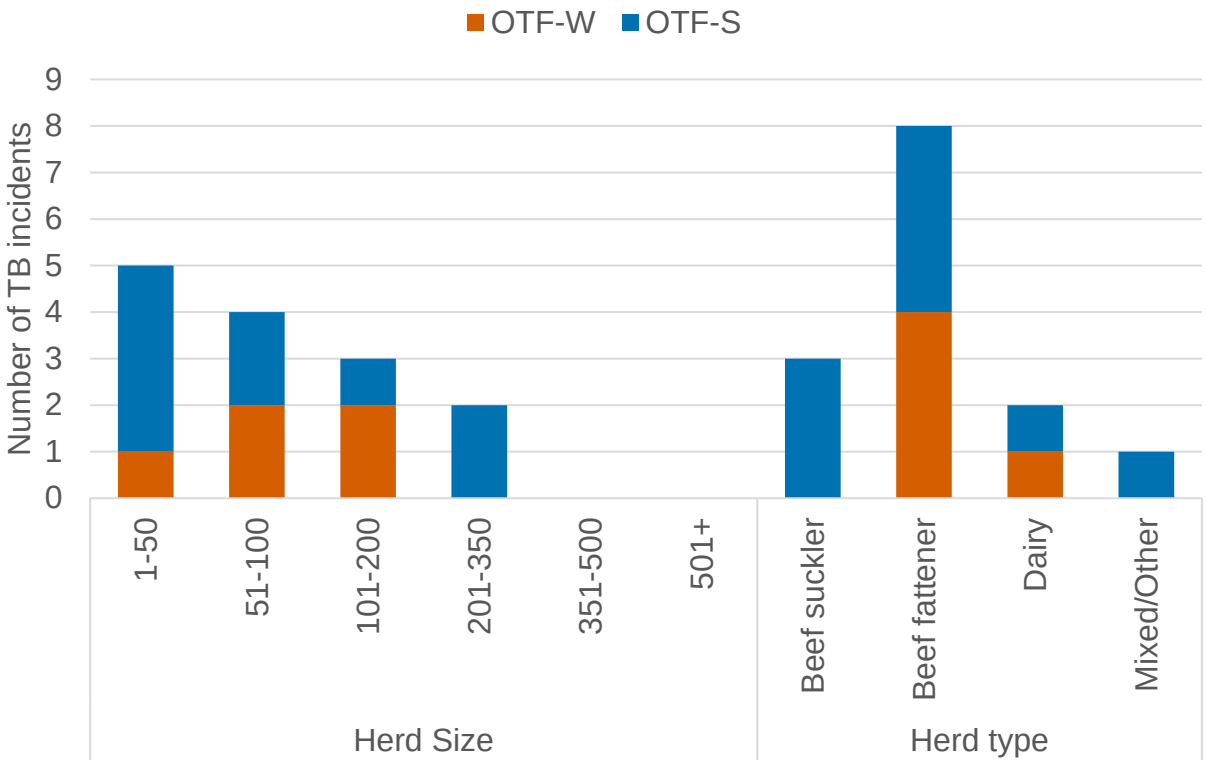

Figure 9: Number of new TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019, by cattle herd size and type.

The distribution of incidents by herd type displays a predominance of incidents in beef cattle (11 incidents in 2019 out of a total of 14) and particularly in beef fattening farms (eight incidents), which tend to present a higher risk of introduction of TB via purchase of infected cattle.

Incidents by month of disclosure

Figure 10 displays the number of new TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019, by month of disclosure. There are expected increases in incidents in the months when cattle testing is increased, particularly before, but also after the summer grazing season.

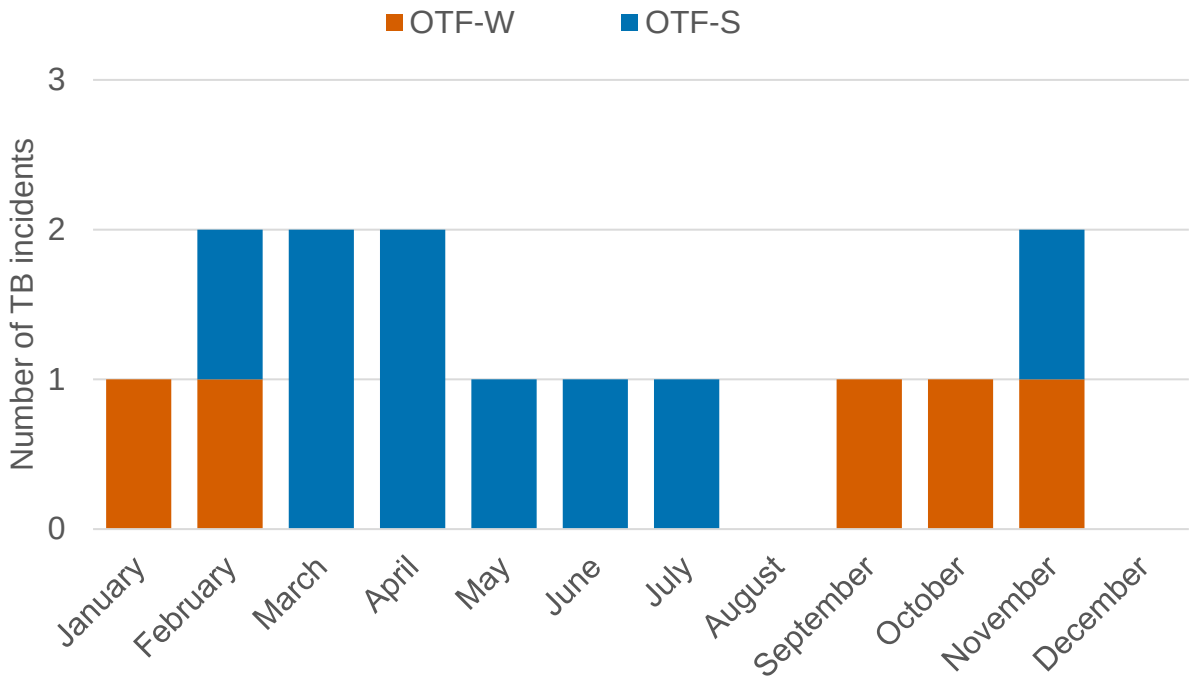

Figure 10: Number of new TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019, by month of disclosure.

Genotypes of *M. bovis* isolated

Figure 11 displays the genotypes of *M. bovis* identified in TB incidents (OTF-W only) in Nottinghamshire in 2019. There were four different genotypes identified in the five OTF-W incidents (Figure 8):

Three incidents highly likely related to purchases of infected cattle:

- Two incidents with genotype 25:a
- One incident with genotype 17:a

Two incidents of undetermined origin:

- One incident with genotype 10:a (located in south Nottinghamshire and being investigated as part of a group of genotype 10:a incidents of undetermined origin disclosed in this area in recent years)
- One incident with genotype 35:a. This incident is located in west Nottinghamshire and there are no other recent local incidents with this genotype, either in Nottinghamshire or in nearby Derbyshire

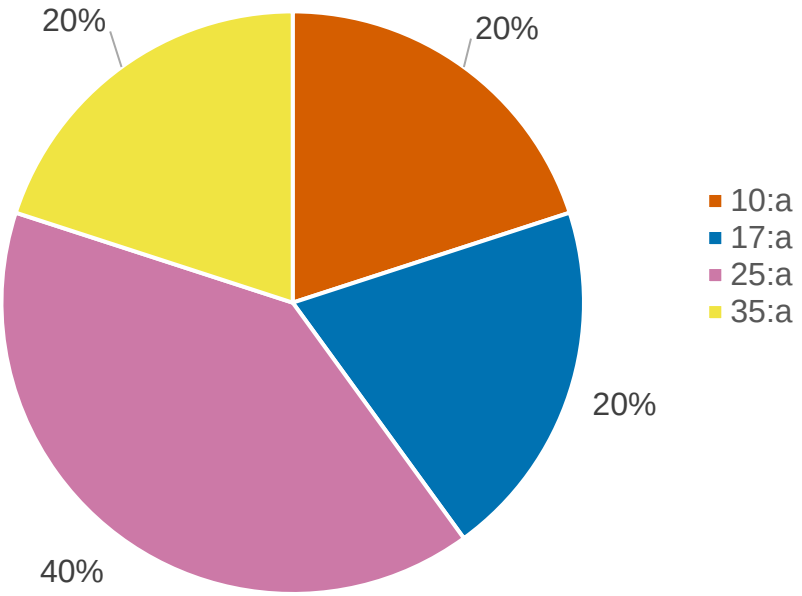

Figure 11: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Nottinghamshire in 2019 (n=5).

Duration of incidents

The duration of TB incidents (OTF-W and OTF-S) closed in Nottinghamshire in 2019 is displayed in Figure 12. The majority of incidents (16 out of a total of 19 incidents that closed in 2019) were resolved before 240 days (eight months) since disclosure, which is indicative of a relatively prompt resolution. Only three incidents lasted longer than 241 days, with no incidents unresolved after 550 days. This will have contributed to the relatively low annual prevalence rate in 2019 observed in Nottinghamshire (1.19), the lowest since 2013 as displayed in Figure 4.

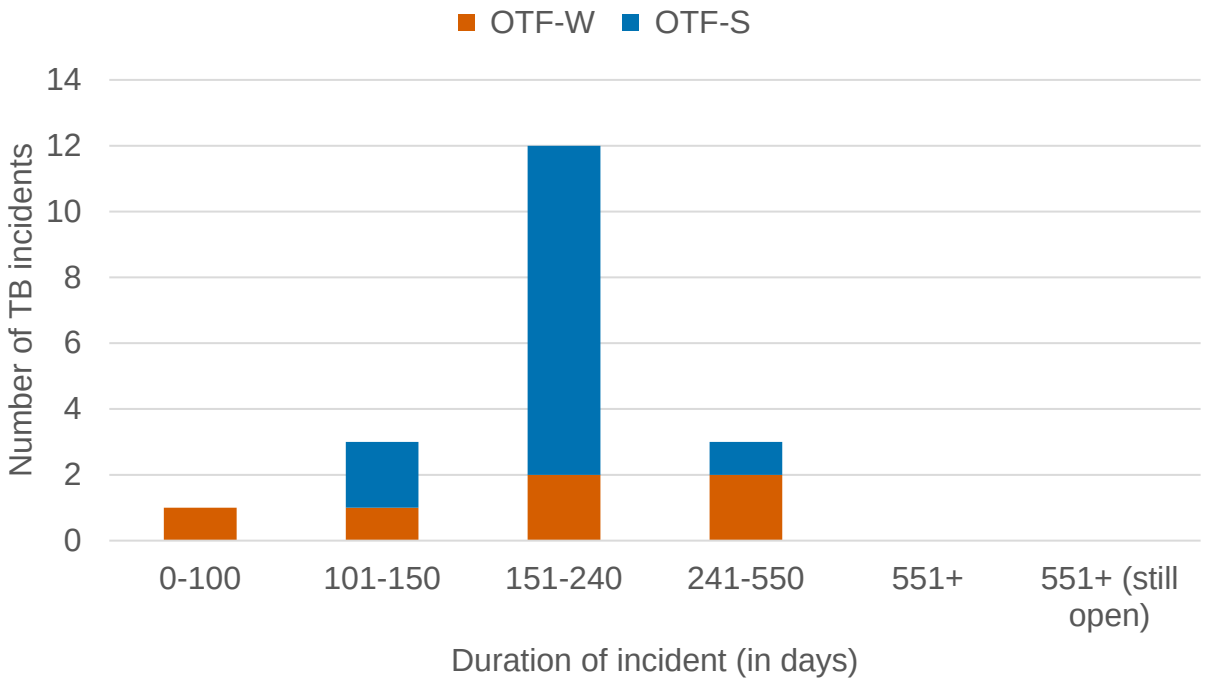

Figure 12: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Nottinghamshire. Note that Approved Finishing Units (AFUs) have been excluded.

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 in Nottinghamshire in 2019 are as follows:

- Cattle purchases
- Other or undetermined sources

Sources of infection and risk pathways

The summary of the weighted source pathways of infection attributed for OTF-W incidents is displayed in Figure13a, and OTF-S incidents are displayed in Figure 13b in Nottinghamshire that started in 2019. The weighted source pathways of infection for all new incidents in 2019 is described in Appendix 4.

Buying in cattle with undisclosed TB infection (27.38% of the weighted source pathways for all 2019 incidents) has been identified as the likely source of infection in three of the five (60%) OTF-W incidents disclosed in 2019 (Figure 14). The three incident farms were fattening units with high cattle throughput and short residence times of the affected cattle. Several fattening units have converted to Approved Finishing Units over recent years, with two more in 2019, which is expected to contribute to the mitigation of this risk.

This has also been identified as a possible source of infection in several OTF-S incidents in 2019, although with high uncertainty associated with the limited evidence for source attribution available in OTF-S incidents.

Possible wildlife infection (9.5% weight) constitutes a considerable decrease from 2018 (40%). This reduction is firstly due to a lower number of incidents in which possible wildlife infection was suspected. Secondly, it is also due to a more balanced and precise selection of possible risk pathways in undetermined incidents. Finally, this decrease is also due to an improved methodology to calculate the contribution of different risk pathways with more accuracy, increasing the weight of uncertainty in some assessments.

There is limited data available on TB surveillance in wildlife and subsequent lack of information on infection levels in wildlife. This must be considered when assessing risk

pathways for infection in incidents with an obscure origin in which direct or indirect contact with wildlife is possible. While the potential involvement of wildlife as an infection source cannot be ruled out, it is associated with a high level of uncertainty.

A known endemic genotype 25:a found in north-east Leicestershire (potential HS23) and the presence of some obscure 10:a genotype incidents identified in south Nottinghamshire (one in 2018 and one in 2019) and north Leicestershire are being closely monitored.

The potential effect of the ongoing (since 2015) Badger Edge Vaccination Scheme is also being monitored.

Undetermined sources (57.14% of the weighted source pathways for all new incidents in 2019) has been identified as the source of infection in two of the five (40%) OTF-W incidents disclosed in 2019 in which the available evidence was not sufficient to identify a clear likely source for introduction of disease in the incident farms (see comment at Figure 11).

This has also been identified as the overall assessment in several OTF-S incidents in 2019, due to the high uncertainty associated with the limited evidence available in these cases.

It is worth highlighting that non-specific reaction to the skin test was identified as a possible cause in some OTF-S incidents in 2019 (5.95% weight), with the caveat of high uncertainty associated with the source attribution of OTF-S incidents. For information on the likelihood and possible causes of non-specific reaction please visit: https://tbhub.co.uk/tb-testing-cattle/skin-testing/tuberculin-skin-testing/

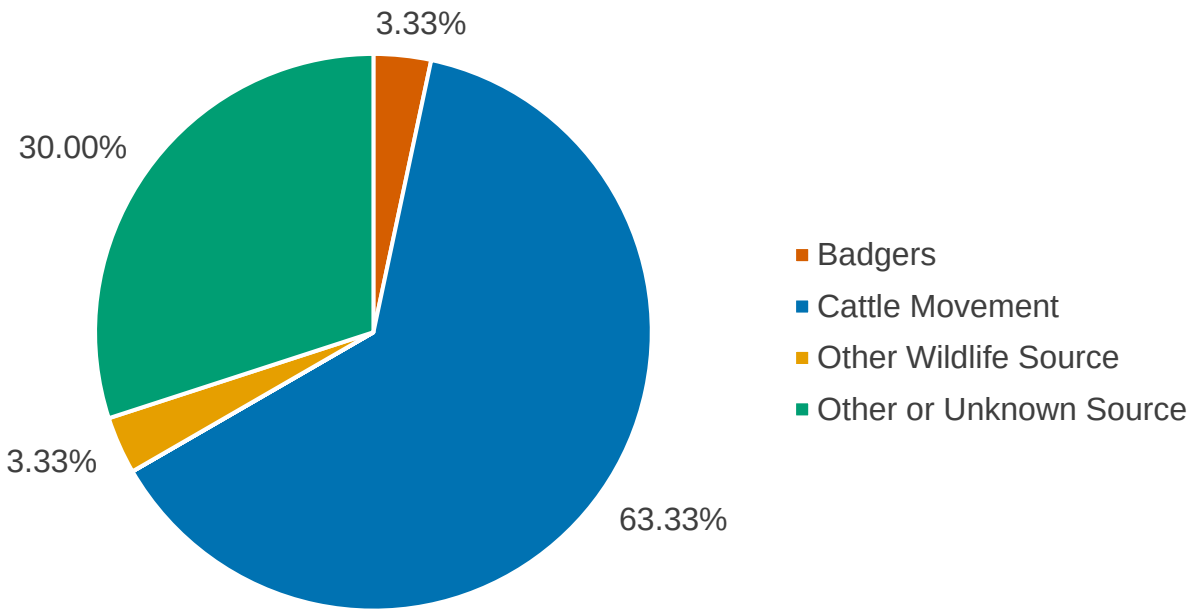

Figure 13a: Summary of the weighted source of infection pathways attributed for all OTF-W incidents in Nottinghamshire that started in 2019, that had a completed DRF (5).

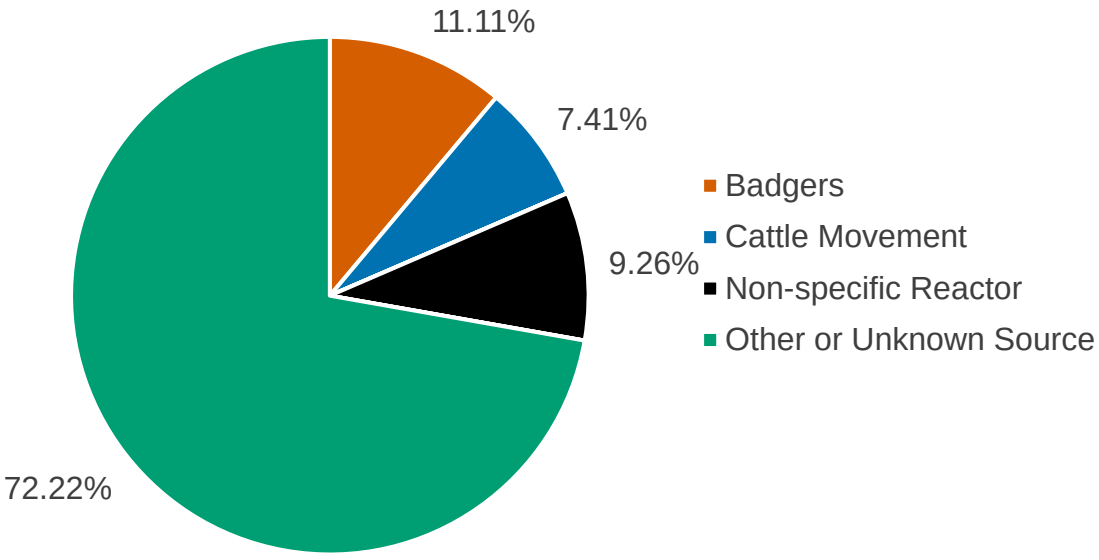

Figure 13b: Summary of the weighted source of infection pathways attributed for all OTF-S incidents in Nottinghamshire that started in 2019, that had a completed DRF (9).

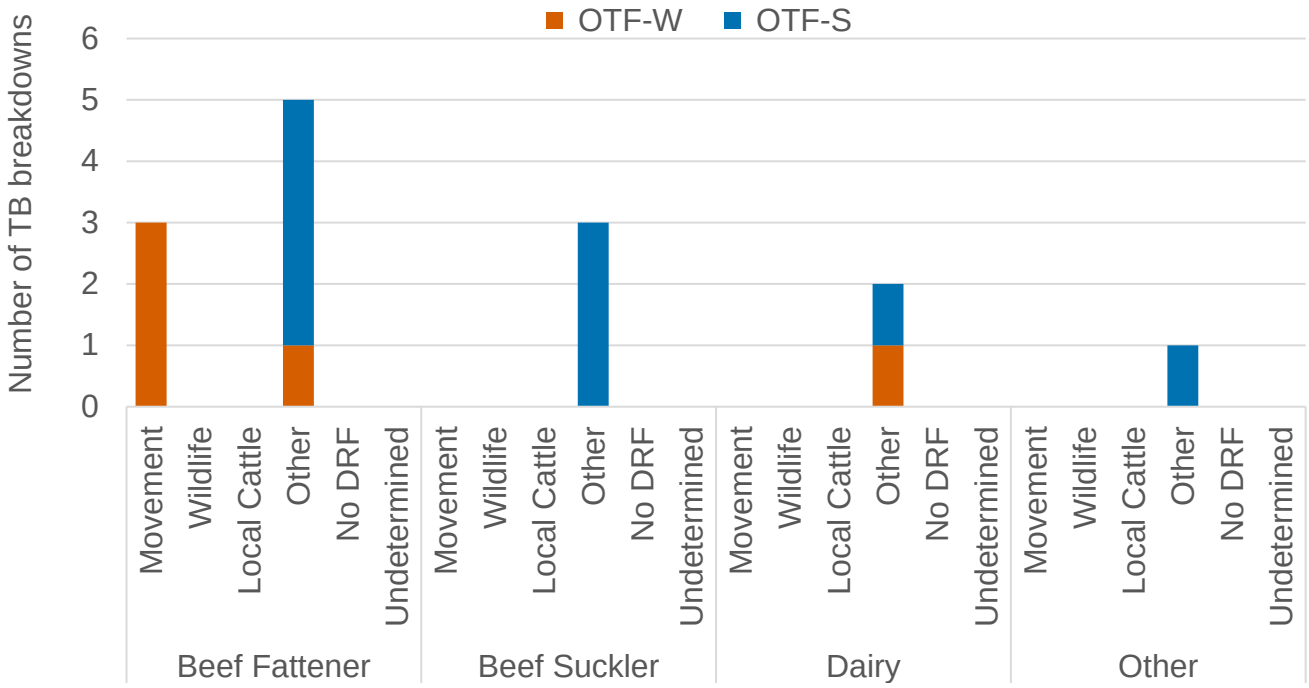

Figure 14: Source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in Nottinghamshire in 2019, by herd type. Note that the categories ‘movement’, ‘wildlife’, and ‘local cattle’ are comprised of incidents where these were the most likely single source 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.

One single case of *M. bovis* in non-bovines was identified in Nottinghamshire in 2019. In March 2019 typical lesions of TB were found at PME of a 16 year old pet cat, euthanised following weight loss and respiratory symptoms (and a six year history of respiratory issues). *M. bovis* was cultured, and spoligotype 21 identified with no additional genotype information. There have been no other recorded spoligotype 21 cases in Nottinghamshire (records since 2011). Spoligotype 21 is most frequently found in south-west England, mainly Somerset and Avon. Following the epidemiological investigation the origin of the case remained undetermined.

Detection of incidents

Figure 15 displays the number of TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019, disclosed by different surveillance methods.

The majority of new incidents were disclosed with routine active surveillance – 10 out of 14 incidents were disclosed at a whole herd test (WHT). However, the majority of OTF-W incidents were disclosed with passive surveillance - three out of five OTF-W incidents were disclosed at routine post mortem meat inspection of non-reactor cattle in slaughterhouses (SLH). This indicates that both active and passive surveillance provide important contributions to the detection of TB in Nottinghamshire.

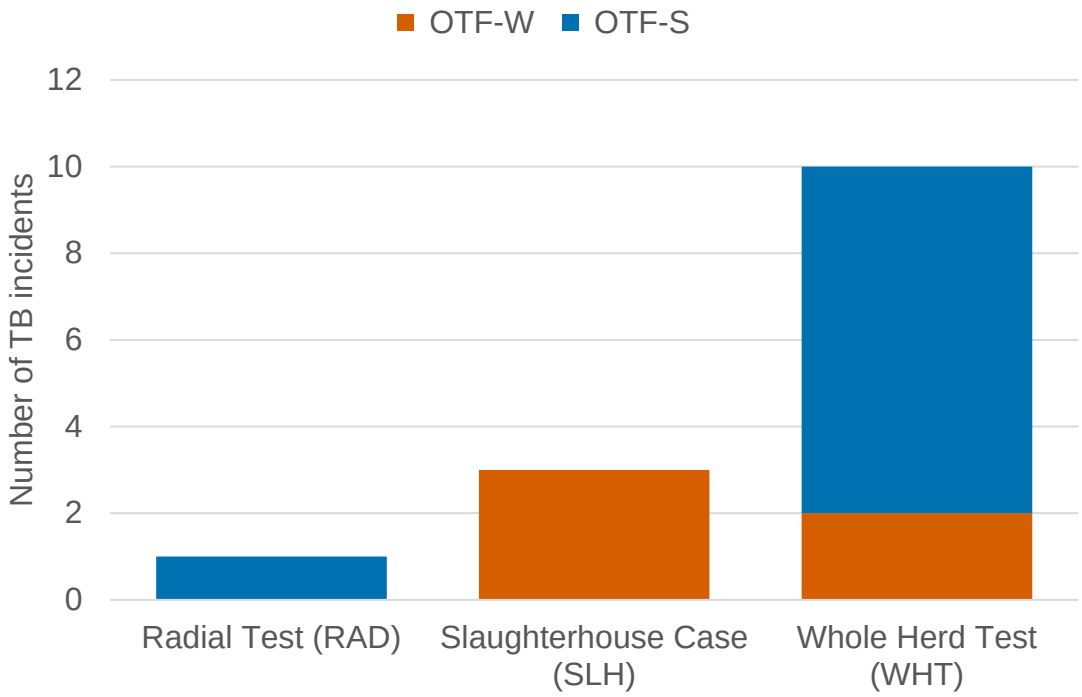

Figure 15: Number of TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019, disclosed by different surveillance methods.

As displayed in Figure 16, out of the 14 TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019, only one had suffered an OTF-W incident in the previous three years, and this previous incident displayed a different genotype to the one in 2019. This indicates that there is effective clearance of disease when it is detected in cattle herds in Nottinghamshire, with no evidence of residual infection.

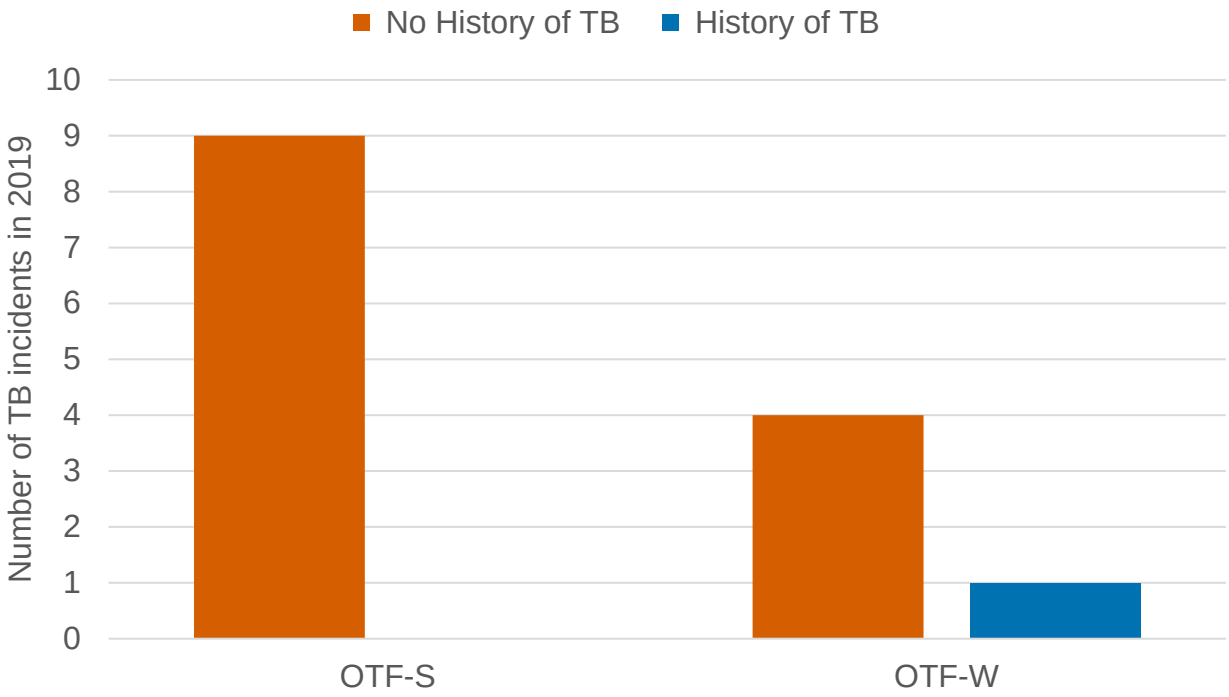

Figure 16: Number of TB incidents (OTF-W and OTF-S) in Nottinghamshire in 2019 on holdings that have suffered an OTF-W incident in the previous three years, and holdings with no history of TB in the previous three years.

Skin test reactors and interferon gamma test positive animals removed

The total number of cattle removed in TB incidents in Nottinghamshire in 2019 was 77 but the majority of these (45) originated from incidents disclosed before 2019. Only 37 cattle were removed from the 14 incidents disclosed in 2019, with the following distribution (with all 14 incidents currently concluded):

Number of skin test reactors found at the initial disclosing test per incident:

- 11 out of 14 new incidents in 2019 had one single reactor initially disclosed
- Two other incidents in which the initial test disclosed two reactors
- One incident was an unusual incident with 19 reactors (see suspected non-specific reactors below).

Number of reactors disclosed during incident testing:

- There were no further skin test reactors disclosed in incident testing in any of the OTF-W and OTF-S incidents disclosed in 2019
- Compulsory interferon-gamma (IFN-γ) testing in OTF-W incidents disclosed three IFN-γ test-positive cattle. There were a further 33 IFN-γ test positive cattle identified from incidents that initiated prior to 2019.

These low numbers of reactors per incident, both at initial disclosing test and at incident testing, together with the relatively short duration of TB incidents (see Figure 12 and related comment) and low annual prevalence rate (see Figure 4 and related comment) in 2019, all point to early detection of disease in Nottinghamshire and a low probability of spread.

Suspected cases of non-specific reactors: One OTF-S incident had 19 reactors found at the disclosing test (including some inconclusive reactors that became reactors following severe interpretation of the test), none of which had typical TB lesions at PME. There were no further reactors at subsequent tests, with three inconclusive reactors negative at retest. Non-specific reaction to the SICCT test is considered a possible reason for this atypical presentation.

No suspected fraudulent (manufactured) skin test reactors were identified in 2019.

Figure 17 indicates the number of reactors detected by IFN-γ and skin tests in Nottinghamshire, from 2010 to 2019. This has been relatively stable since 2013 (except for a peak in 2014), with an annual impact on the taxpayer of approximately 70 to 80 reactors in which compensation for compulsory removal has to be paid.

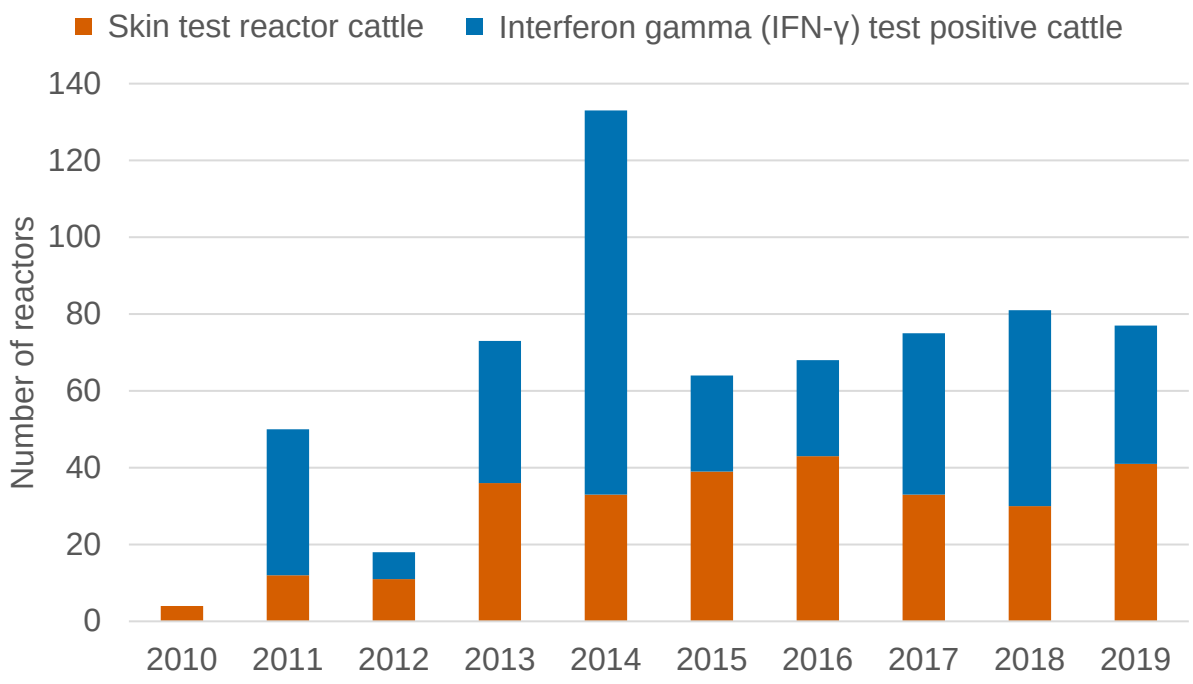

Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Nottinghamshire, 2010 to 2019.

The financial impact on farmers of reactor removal has been relatively low for incidents detected in Nottinghamshire in 2019 (due to the low number of reactors removed per incident), with the exception of a farm in which 19 reactors were detected.

The impact of the duration of movement restrictions has also been relatively low given the low number and short duration of incidents in 2019.

Summary of risks to Nottinghamshire

An endemic area (potential HS23) has been identified across south-west Nottinghamshire, north-east Leicestershire (Edge), and a small part of south-west Lincolnshire (LRA) and in which genotype 25:a of *M. bovis* has been identified. By the end of 2019, enhanced wildlife surveillance in HS23 had identified two badger carcases with visible lesions consistent with TB at post mortem examination. 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).

While no incidents related to this endemic cluster have been disclosed in Nottinghamshire in 2019, given the knowledge gap in wildlife surveillance in the Edge Area, there is significant uncertainty about the current level of risk.

Cattle densities in south Nottinghamshire near Leicestershire are high, increasing the potential risk of TB spread.

Summary of risks from Nottinghamshire to surrounding areas

There are no endemic areas currently identified in Nottinghamshire.

The TB risk from Nottinghamshire to adjacent counties appears to be low, but there are two points in which the uncertainty is relatively high and must be highlighted:

- One OTF-W incident with genotype 10:a located in south Nottinghamshire (near the border with Leicestershire) of undetermined origin is being investigated as part of a small group of genotype 10:a incidents of undetermined origin in this area which also includes some incidents in Leicestershire
- The origin of a high proportion of the new OTF-S incidents in Nottinghamshire in 2019 was undetermined, due to the lack of sufficient information

In both cases, given the knowledge gap on wildlife surveillance, the possibility of wildlife involvement in the transmission of TB could not be ruled out and this potential risk needs to be closely monitored.

Cattle densities in Nottinghamshire near the LRA county borders appear to be low (see Figure 6), which could mitigate any potential risk of TB spread.

Assessment of effectiveness of controls and forward look

Overall, the TB epidemic in Nottinghamshire appears currently stable, with 2019 surveillance data indicating a slight improvement from 2018 data. The results in 2020 will confirm if this is likely to point to a change in trend or if it is due to the cyclical nature of the epidemic.

The concern highlighted in the report for 2018 that wildlife reservoirs could be playing a bigger part than previously thought, has not worsened in 2019, although the significant knowledge gap in wildlife surveillance persists. Any incidents of concern are closely monitored.

The objective to reduce OTF-W herd incidence to <1% by 2025 appears achievable if the positive trend is maintained.

The objective to attain OTF status (crude incidence of indigenous OTF-W herd incidents <0.1%) for the lowest incidence counties in the Edge Area depends on the evolution of the endemic *M. bovis* genotype 25:a front in north-east Leicestershire (potential HS23) and on the evolution of the obscure 10:a genotype incidents identified in south Nottinghamshire and north Leicestershire.

Appendices

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

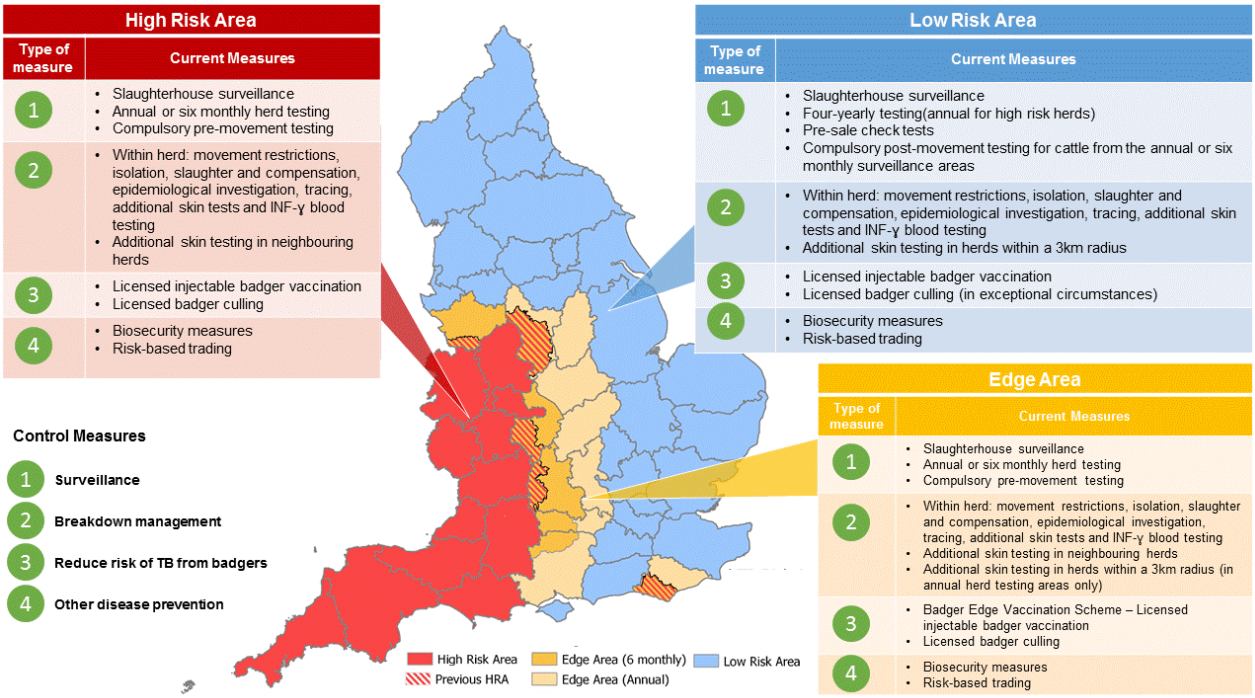

Figure A1.1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Bovine Tuberculosis Free status for England. Map based on information published on www.tbhub.co.uk.

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 Nottinghamshire

Edge Area testing policy:

- No discretionary measures implemented in OTF-S incidents i.e. none were subjected to discretionary IFN-γ testing
- Mandatory IFN-γ testing of new OTF-W incident herds in 2019 found three IFN-γ positive animals (8% of all reactors). Mandatory IFN-γ testing of OTF-W incident herds that started before 2019 found 33 additional IFN-γ positive animals in 2019
- There were no exemptions applied to the deployment of IFN-γ testing in OTF-W incidents, although the blood test was not carried out in three OTF-W incidents as the farms were depopulated for operational reasons (all three were finishing units)
- There were no exemptions applied to the deployment of radial testing
- There were no persistently infected herds or incidents where enhanced case management was recommended in 2019

Other testing measures:

- Ongoing investigation of OTF-W incidents aided with analysis of Whole Genome Sequencing (WGS) to determine the links between these incidents and other local incidents in Leicestershire and Lincolnshire, and to increase certainty in attributed infection risk pathways
- Occasionally testing does become overdue, but it 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 Nottinghamshire in 2019

Other control measures:

- Regional meetings held with farmers in the TB eradication group of the Vale of Belvoir area (south Nottinghamshire and north Leicestershire), led by the National Farmers Union
- Provision of free biosecurity advice by the TB Advisory Service (TBAS, www.tbas.org.uk/)
- Badger found dead survey in the Edge Area completed by the Universities of Nottingham and Surrey. Results pending publication
- Badger Edge Vaccination Scheme (BEVS): The four-year projects which Defra funded under the original BEVS which started in 2015 were terminated in 2016 due to a worldwide 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. An expanded version of the previous NWT project was approved and started in May 2018. This continued during 2019, with 65 badgers vaccinated in 2019 (40 adults and 25 cubs)

Appendix 2: cattle industry in Nottinghamshire

Table A2.1: Number of cattle premises by size band in Nottinghamshire 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	4	240	64	69	36	12	16	441	101	44

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of Cattle	29,901 (66%)	13,532 (30%)	1312 (2%)	0	44,745

Appendix 3: summary of headline cattle TB statistics

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

Herd-level statistics	2017	2018	2019
(a) Total number of cattle herds live on Sam at the end of the reporting period	531	514	515
(b) Total number of whole herd skin tests carried out at any time in the period	469	518	514
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	425	421	413
(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)	507	486	496
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	521	502	507
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	13	17	14
• OTF-S	8	8	9
• OTF-W	5	9	5
(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?	1	2	3
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	4	3	2

Herd-level statistics	2017	2018	2019
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.)	1	4	0
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	0	2	3
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	NA	1	1
• OTF-W	NA	2	0
(i) Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W incidents that began in a previous reporting period, but not including non-grazing Approved Finishing Units)	5	5	4
(j) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	0	0	1 Cat
(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	6	7	9
• Exempt Finishing Units: Grazing	0	0	0
• Exempt Finishing Units: Non Grazing	1	1	1

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)	56,633	56,503	58,057
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	33	30	41
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	42	51	36
(c) Reactors detected during year per incidents disclosed during year *	5.8	4.8	5.5
(d) Reactors per 1000 animal tests	1.3	1.4	1.3
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	2	0	3
• Private slaughters	2	4	6
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	1	6	12
(g) SLH cases confirmed by culture of *M. bovis* **	0	5	4

* 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 Nottinghamshire, in 2019.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	7	0	0	0	8.3%
Cattle movements	5	0	0	3	27.4%
Contiguous	0	0	0	0	0.0%
Residual infection	0	0	0	0	0.0%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	5	0	0	0	6.0%
Fomites	0	0	0	0	0.0%
Other wildlife	1	0	0	0	1.2%
Other or unknown source	13	0	0	0	57.1%

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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