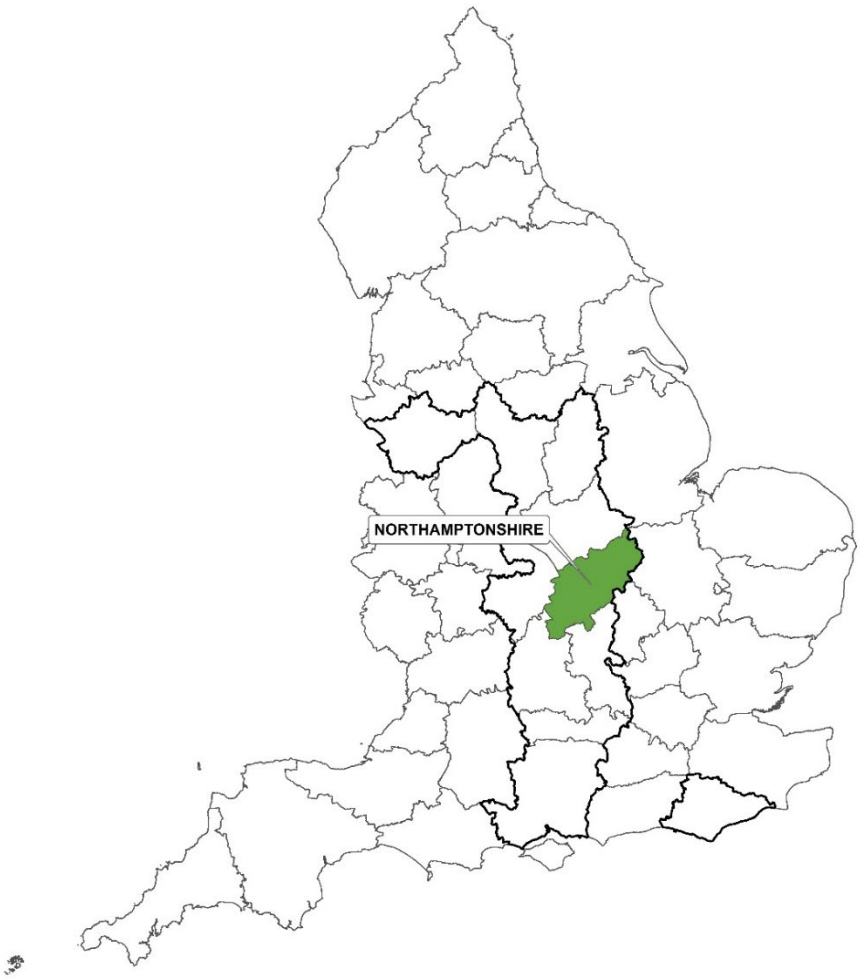
Animal & Plant Health Agency

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

County: Northamptonshire

Year-end report for: 2020

TB Edge Area - NORTHAMPTONSHIRE



TR398 (Rev. 03/21)

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Executive summary

Reporting area

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

Local cattle industry

Northamptonshire has low herd and cattle density, with the majority of cattle situated in the western half of the county. Small to medium size beef suckler and fattening herds predominate, with dairy animals only accounting for approximately 12% of the cattle population.

There is a single livestock auction market (in Thrapston), but substantial trade of cattle occurs through Rugby market in Warwickshire and Thame market in Oxfordshire (both Edge Area counties adjoining Northamptonshire).

New TB incidents

The number of new incidents has been rising consistently over the last six years, reaching 37 in 2020, an increase of three from 2019. This has led to the increasing trend in the annual herd incidence rate, reaching 8.8 incidents per 100 herd-years at risk in 2020.

Despite this increase, Northamptonshire continues to have the sixth lowest incidence amongst the other Edge Area counties, approximately 12% below the average incidence of the Edge Area (10.1).

COVID-19 epidemic has caused slight increase in the numbers of overdue tests in 2020 but they were all (except for one outstanding for reasons other than the epidemic) were resolved by the end of the reporting period. There is no evidence at present that COVID-19 epidemic had direct negative impact on disease control.

Risk pathways for TB infection

Wildlife was considered a key driver of infection for cattle herds in Northamptonshire in 2020, with badgers providing a weighted contribution of 56% of all risk pathways. This was followed by inward movement (purchase) of cattle (with a weighted contribution of 27%), with residual cattle infection and undetermined source of infection at 6%.

Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement to the 2020 bovine TB epidemiology reports.

Disclosing tests

Enhanced surveillance testing such as radial, six-monthly post-incident and trace testing detected nearly half (49%, 18 out of 37) of the new incidents in 2020.

Slaughterhouse surveillance (routine post-mortem meat inspection of cattle carcases) detected 5% (2 out of 37) of infected herds, with the remainder being disclosed by compulsory pre-movement tests (5%, 2 out of 37) and routine annual whole herd tests (30%, 11 out of 37).

Reactor numbers

In 2020, 159 skin test reactors were removed, a decrease of 89 on 2019 when the highest number in the last decade was recorded (248). There were 74 interferon gamma (IFN-γ) test positive animals, nearly half the number disclosed in 2019 (171) and similar to that found in 2018 (78).

Risks to the reporting area

The areas of Northamptonshire with the greatest herd and cattle density are near the adjoining Edge Area counties of Warwickshire and Oxfordshire, which have a much higher incidence of TB.

These two counties pose a risk due to the significant flow of cattle into Northamptonshire through their livestock markets and through shared populations of wildlife (badger and deer) across borders. These wildlife may be infected as pockets of endemic *M. bovis* infection have been indentified..

The High Risk Areas of England and Wales are supplying, either directly or through markets and/or dealers, a significant proportion of the fattening cattle for finishing business in Northamptonshire. This has given a rise to the number of introduced infections in 2020 with anecdotal evidence of these leading to spill over events into local wildlife.

Risks posed by the reporting area

The risk posed by Northamptonshire to the adjoining Low Risk Area (LRA) counties is still low. This is due to the geographical distance between the endemic areas of the county and the LRA, between which is a buffer area of low herd and cattle density. There is an increased (but still very low) level of incidence near the Cambridgeshire border. The risk from Northamptonshire to the LRA needs to be closely monitored.

The risk posed by Northamptonshire to the adjoining Edge Area counties varies. The risk to Warwickshire and Oxfordshire is lower, or at best equal, to the risk they represent to Northamptonshire. A new cluster of incidents near the Leicestershire border may be a potential new endemic area and may cause disease ingress to Leicestershire from Northamptonshire. There is no evidence currently suggesting any risks to Buckinghamshire associated with disease being moved in either direction via cattle or wildlife.

Forward look

Herd incidence is steadily increasing despite implementation of enhanced surveillance and control measures applied at the? herd level in Northamptonshire. This is compromising the goal of achieving OTF status for the county and urgent actions are required to address the disease burden.

Tighter control over purchased stock, such as introduction of compulsory post-movement testing, may help address the risk posed by cattle sourced from higher incidence areas. Measures tackling disease in wildlife populations in Northamptonshire west of the M1 motorway are paramount.

Introduction

This report describes the level of bovine tuberculosis in cattle herds in Northamptonshire in 2020. Bovine tuberculosis is caused by the organism *Mycobacterium bovis* (*M. bovis*) and will subsequently be referred to as TB.

This report explores the frequency and geographical distribution of TB in cattle herds. It examines what is likely to be driving TB in this area, and the risks the disease in this county may pose to neighbouring cattle.

Although other sources may refer to TB 'breakdown(s)', this report will use the term 'incident(s)' throughout. This report is intended for individuals involved in the control of TB, both in the local area and nationally. This includes but is not limited to farmers, veterinarians, policy makers and the scientific community.

In 2014 the Government published its Strategy to achieve Officially TB Free (OTF) status for England by 2038. A key action was to recognise the different levels of TB in different parts of the country and to vary the approach to control accordingly. To this end three management areas were established (refer to Appendix 1).

Northamptonshire forms part of the Edge Area. Control efforts are seeking to slow down and reverse geographic spread, and to reduce the incidence rate. The aim is to obtain OTF status for the Edge Area as soon as possible.

Changes to the Edge Area

On 1 January 2018 the Edge Area boundary was expanded westwards to absorb the former High Risk Area (HRA) parts of the five previously split counties. Cheshire, Derbyshire, Warwickshire, Oxfordshire, and East Sussex all moved fully into the Edge Area.

Furthermore, the routine TB testing frequency of herds in the counties in the west of the Edge Area adjoining the HRA (or parts thereof) was increased from annual to six-monthly. The respective descriptive TB epidemiology reports for those five counties of the Edge Area will focus on the whole county and key differences between the old and new parts will be highlighted where relevant.

The changes of January 2018 to the Edge Area boundary did not affect the county of Northamptonshire. 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 Northamptonshire and all the other parts of the Edge Area that remained on annual testing.

Changes due to COVID-19

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

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

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

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

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

Cattle industry

Herd types

Cattle density in Northamptonshire is low compared to neighbouring counties. The cattle population is unevenly distributed and is concentrated in the western half of the county. Over the last six years the cattle population has been steadily decreasing, by roughly 1,000 animals a year, with the greatest reduction seen in 2020, by 3,600 cattle (see Table A2.2 in Appendix 2).

This is reflected by the reduction in both the average and median herd size over the reporting period (see Table A2.1 in Appendix 2). Small holdings (fewer than 50 cattle) account for 48% of the herds, with only 5% of the holdings having more than 351 cattle (Figure 1).

Most herds are beef suckler or beef fattening herds. As expected, beef-sired breeds continue to predominate (85%), although there was a slight increase in the small proportion of dairy-sired cattle (12%, Table A2.2 in Appendix 2).

Traditional farming practices where cattle are grazed during the summer months and housed over the winter are the most commonly observed. Fragmented farming, with pieces of land scattered across a wide area, is frequent and is having an impact on TB risk due to cattle movement between different areas whilst within the same holding (where land is within ten miles of the main premises).

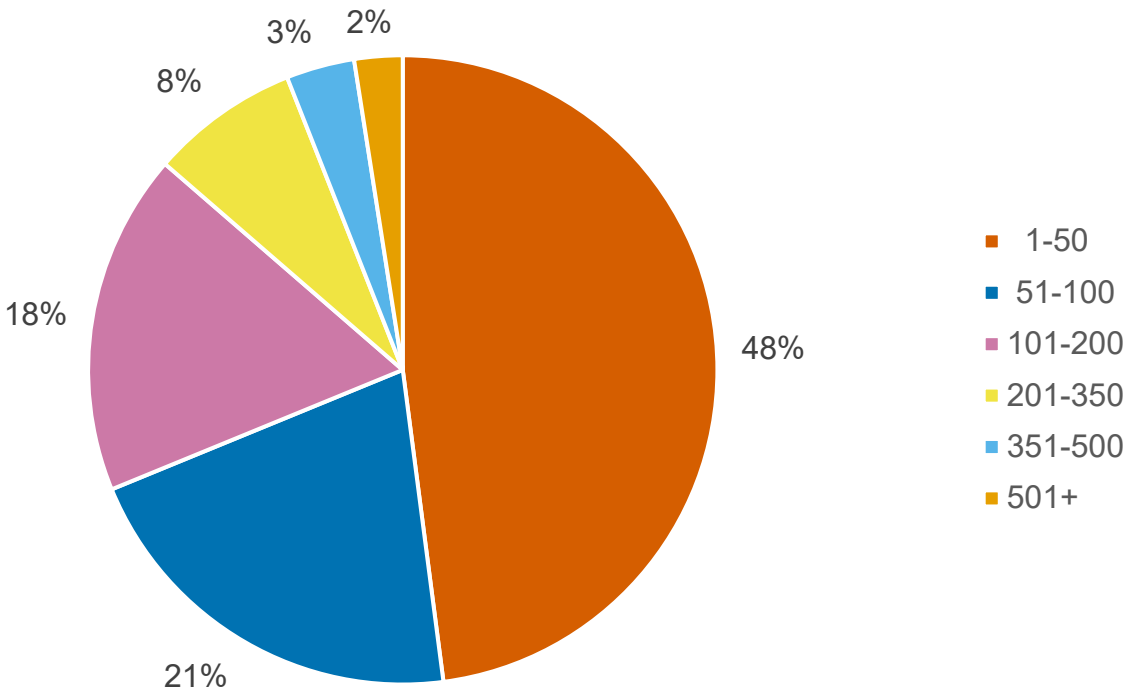

Figure 1: Proportion of cattle holdings in Northamptonshire, by herd size in 2020 (n=484). Note: herds with an undetermined size are not shown.

Markets and abattoirs

Northamptonshire has one livestock auction market in the town of Thrapston, located in the eastern part of the county where the herd and cattle density is the lowest.

The main flow of cattle is through Rugby market in Warwickshire and Thame market in Oxfordshire. Both counties are in the Edge Area, with significantly higher TB incidence than that in Northamptonshire.

The services of cattle dealers are largely relied upon; therefore, a significant proportion of cattle enter the county from markets in high TB risk areas in England and Wales.

There are no slaughterhouses in Northamptonshire contracted for the slaughter of TB test reactor cattle. Traditionally three livestock shows take place in the county, however these were all cancelled in 2020 due to the COVID-19 epidemic.

Approved Finishing Units

Approved Finishing Units (AFUs) without grazing have their cattle housed at all times in wildlife-proof buildings and are exempt from routine surveillance testing.

AFUs provide an important and much needed outlet for the fattening and/or finishing of negative tested cattle from TB-restricted holdings. In 2020, during unannounced inspections by APHA, two of the 13 registered AFUs in Northamptonshire were found non-compliant with the biosecurity requirements.

Their approval was suspended until all deficiencies were rectified. There is no evidence at present that this has led to increased TB incidence around those units.

Pre-movement Testing Exempt Finishing Units (EFUs) provide another alternative route for beef finishing enterprises to purchase animals intended for slaughter, without the need for pre-movement testing. There was only one EFU registered in Northamptonshire in 2020, no change from 2019.

Common land

There was no common grazing land in Northamptonshire in 2020.

Descriptive epidemiology of TB

Temporal TB trends

Three analytical measures are used to describe the level of TB infection in these reports.

1. The number of new herd incidents that were disclosed in each year (Figure 2).
2. The annual herd incidence rate, reported as the number of new incidents per 100 herd-years at risk (100 HYR) (Figure 3). This is the number of new TB incidents detected in the year, divided by the time those herds were at risk of contracting TB. The 100 HYR incidence rate is used in this report as it accounts for different intervals between herd tests that other incidence measures do not (such as new TB incidents per number of herds or tests).
3. The annual end of year herd prevalence (Figure 4). This is the number of herds under restriction due to a TB incident, divided by the number of active herds at the same point in time. Prevalence provides a snapshot of the burden of TB on the local cattle industry.

All three measures include Officially Tuberculosis Free Status Withdrawn (OTF-W) incidents, and Officially Tuberculosis Free Status Suspended (OTF-S) incidents.

OTF-W incidents are those where 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 disclosed during the Single Intradermal Comparative Cervical Tuberculin (SICCT) skin test, with non-visible lesions during the post-mortem examination and negative on culture results.

TB incidents in non-grazing AFUs are not included in the prevalence and incidence calculations (excluding Figure 5) in this report due to the limited epidemiological impact of these cases.

Furthermore, herds restricted because of an overdue test rather than a TB incident are also excluded from calculations. Hence measures of incidence and prevalence in this report may be lower than those reported in the official TB statistics.

Over the last five years, Northamptonshire has seen a growth in the number of new incidents, with the greatest number recorded in 2020 (37), an increase of three on the previous year (Figure 2).

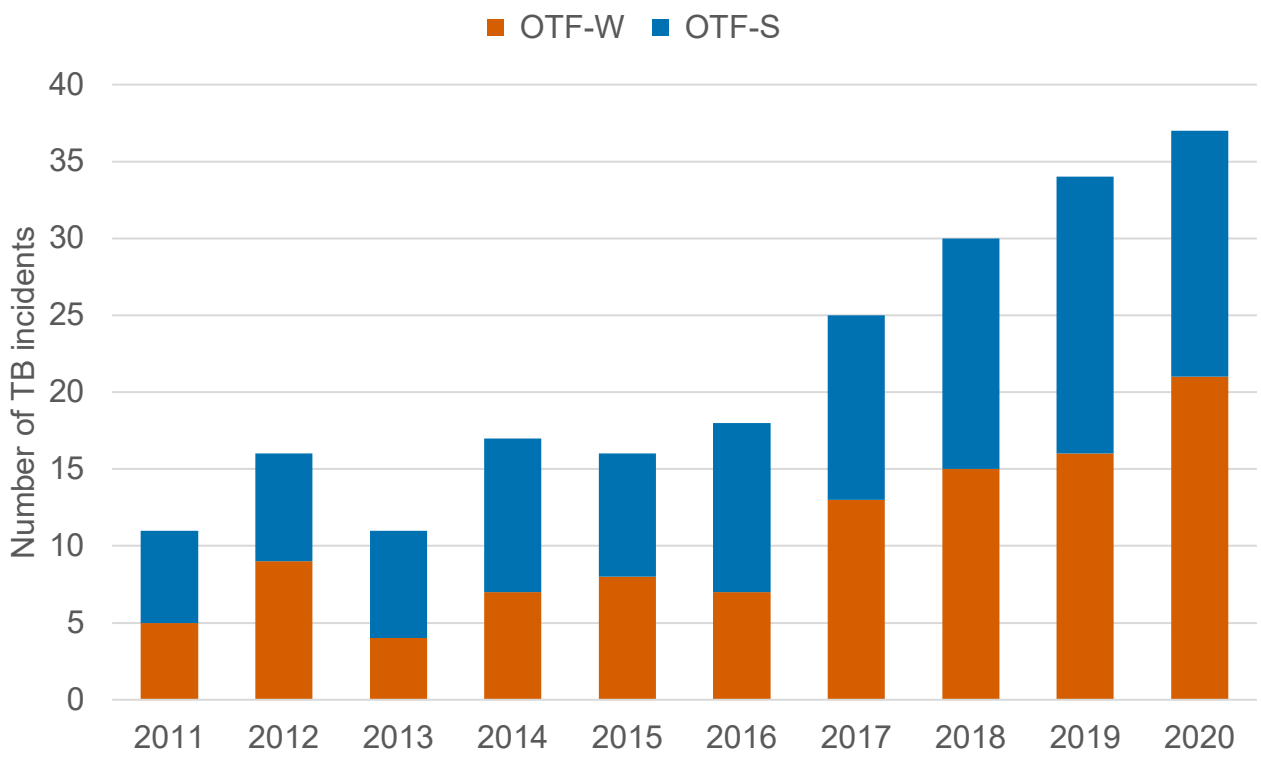

Figure 2: Annual number of new TB incidents in Northamptonshire, from 2011 to 2020.

The effect of the continual reduction in the number of herds coupled with the greater number of incidents in 2020 was also reflected in the increased herd incidence rate. In 2020 the incidence rate was 8.8 new TB incidents per 100 herd-years at risk, which has nearly tripled since 2015 (Figure 3).

One of the specific short-term objectives of the Edge Area policy was to maintain herd incidence of OTF-W incidents below 2% overall by 2019. This objective was not achieved, with crude OTF-W incidence reaching 4.3% in 2020. These figures take Northamptonshire even further away from the progress towards achieving OTF status.

Herd prevalence at the end of 2020 (4.10%) rose compared to 2019 (3.44%) (Figure 4). However, this is a measure largely influenced by the timing of the incidents' detection and their duration.

In 2020, just over one third (14 out of 37) of the new herd incidents in Northamptonshire were detected in the last quarter of the year, which means there was not sufficient time for them to resolve by the year's end, thus contributing to the observed increase in prevalence.

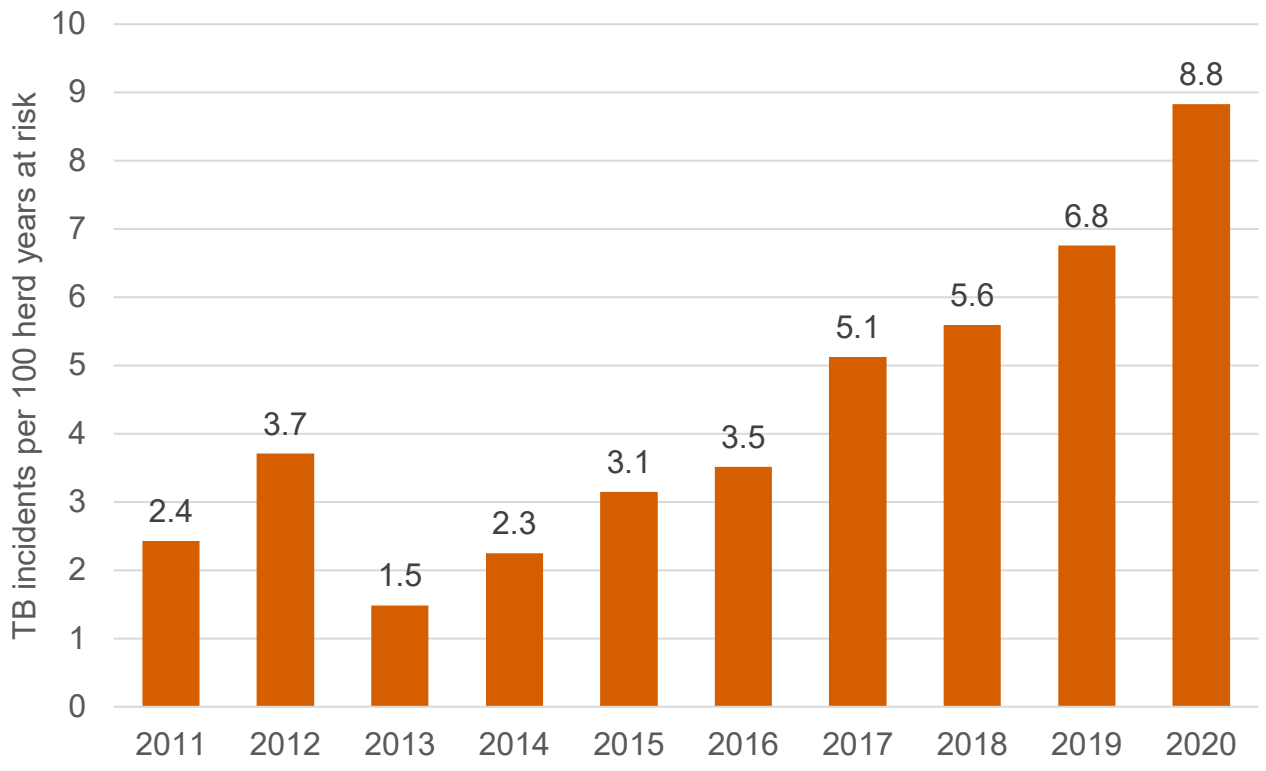

Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Northamptonshire, from 2011 to 2020.

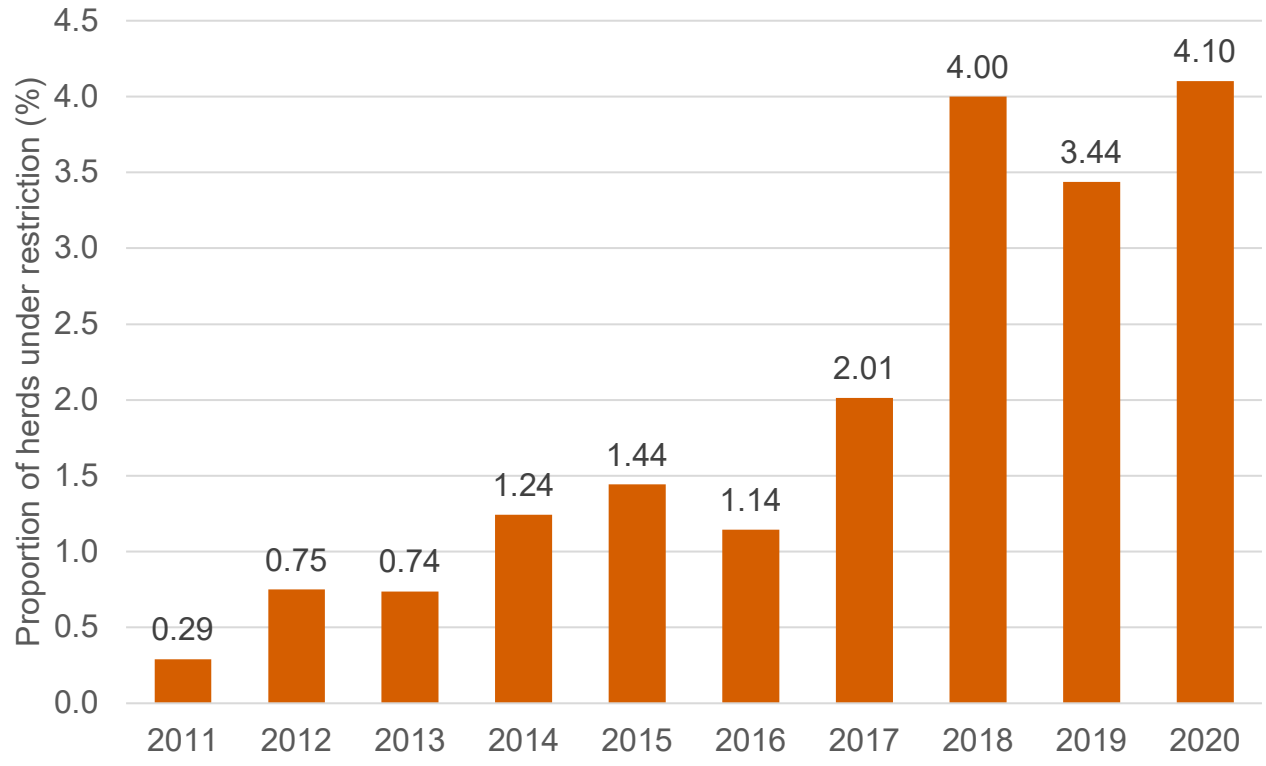

Figure 4: Annual end of year prevalence in Northamptonshire, from 2011 to 2020.

Geographical distribution of TB incidents

Northamptonshire's incident rate (8.8 incidents per 100 herd-years at risk) remains below the average for the Edge Area (10.1) and the HRA (16.25) despite the increased herd incidence in 2020 (Figure 5).

While the bordering Edge counties of Warwickshire (14.83) and Oxfordshire (19.69) both saw decreases in their incidence in 2020 from 2019, they are still representing a significant risk with their incidence above the average for the Edge Area.

Leicestershire, another bordering Edge Area county, also sustained an increase in its incidence (7.67) in 2020 compared to 2019 but remained lower than Northamptonshire.

The distribution of cattle in Northamptonshire in 2020 was much the same as in 2019, with higher herd and cattle densities being concentrated alongside the Warwickshire, Leicestershire, Oxfordshire, and Buckinghamshire borders.

However, these areas with greater cattle density have continued to recede, whilst the areas of very low cattle density (around Wellingborough to the east, Banbury to the south and King's Cliffe to the north) have been expanding in size. This reflects the overall reduction in number of cattle and cattle herds compared to 2019 (Figure 6).

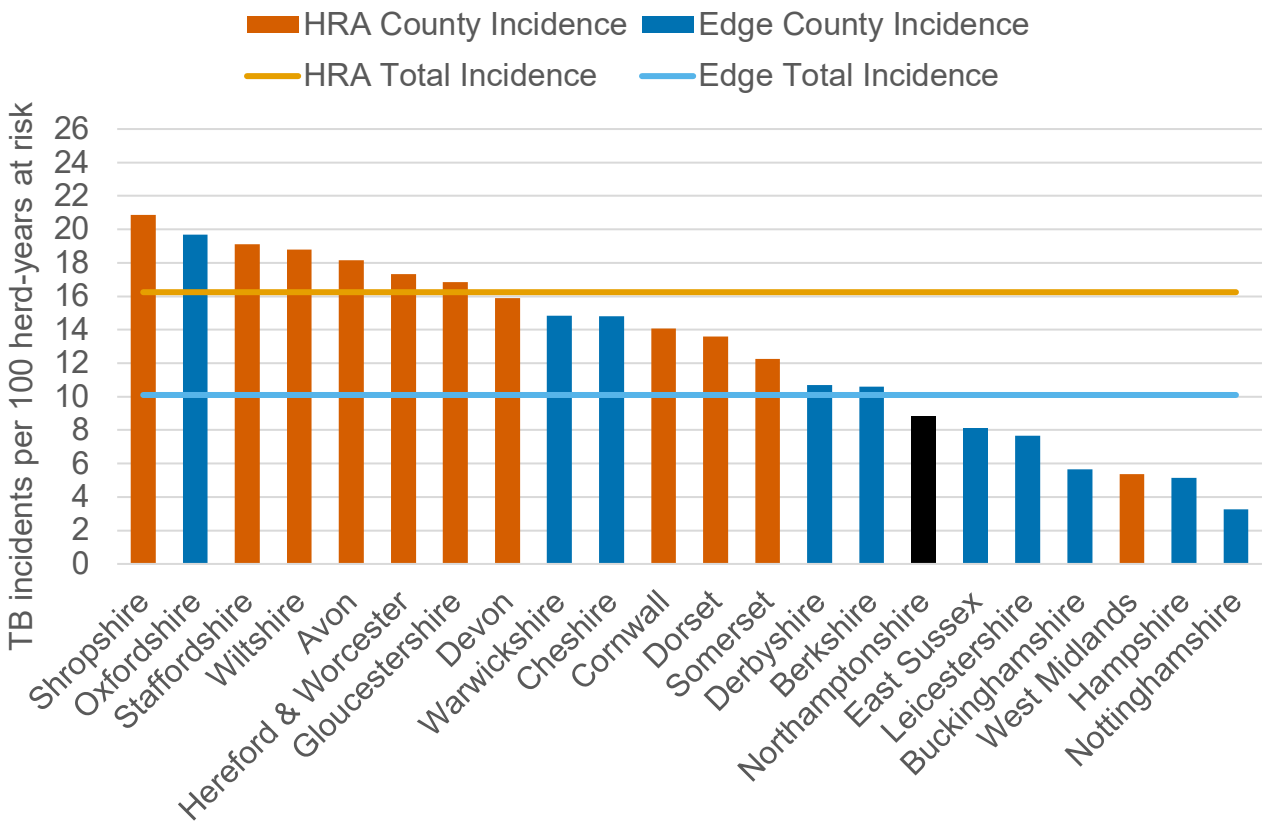

Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S including finishing units) in 2020, by HRA and Edge Area county, highlighting the county of Northamptonshire.

Denser cattle population is generally associated with greater numbers of incidents especially when combined with proximity to higher incidence and endemic areas. A high number of incidents continue to occur in the Daventry cluster, which has been persisting since 2016.

Most of the incidents remain consistently located along the county border with Warwickshire and north Oxfordshire, with an eastward scatter along the B4525 road into Northamptonshire. To a great extent this mirrors the epidemiological picture of the last few years (Figure 6 and Figure 7).

The whole area of the county west of the M1 motorway continues to experience high disease burden with recurring incidents and herds with no previous TB history becoming affected. There is significant observational evidence gathered during epidemiological investigations by APHA veterinarians using disease report forms (DRFs) that TB susceptible wildlife (both badgers and deer) are abundant with plenty of suitable habitat in this area.

With the additional information provided by molecular typing and phylogenetic analysis of *M. bovis* isolates from these herds it is apparent that disease has become endemic in this particular area, with 10:a genotype homerange expanding for very first time across Warwickshire and Oxfordshire border into Northamptonshire.

The possibility of spread via local infected cattle has been carefully assessed and ruled out, leaving wildlife (mainly badgers) as the main vector.

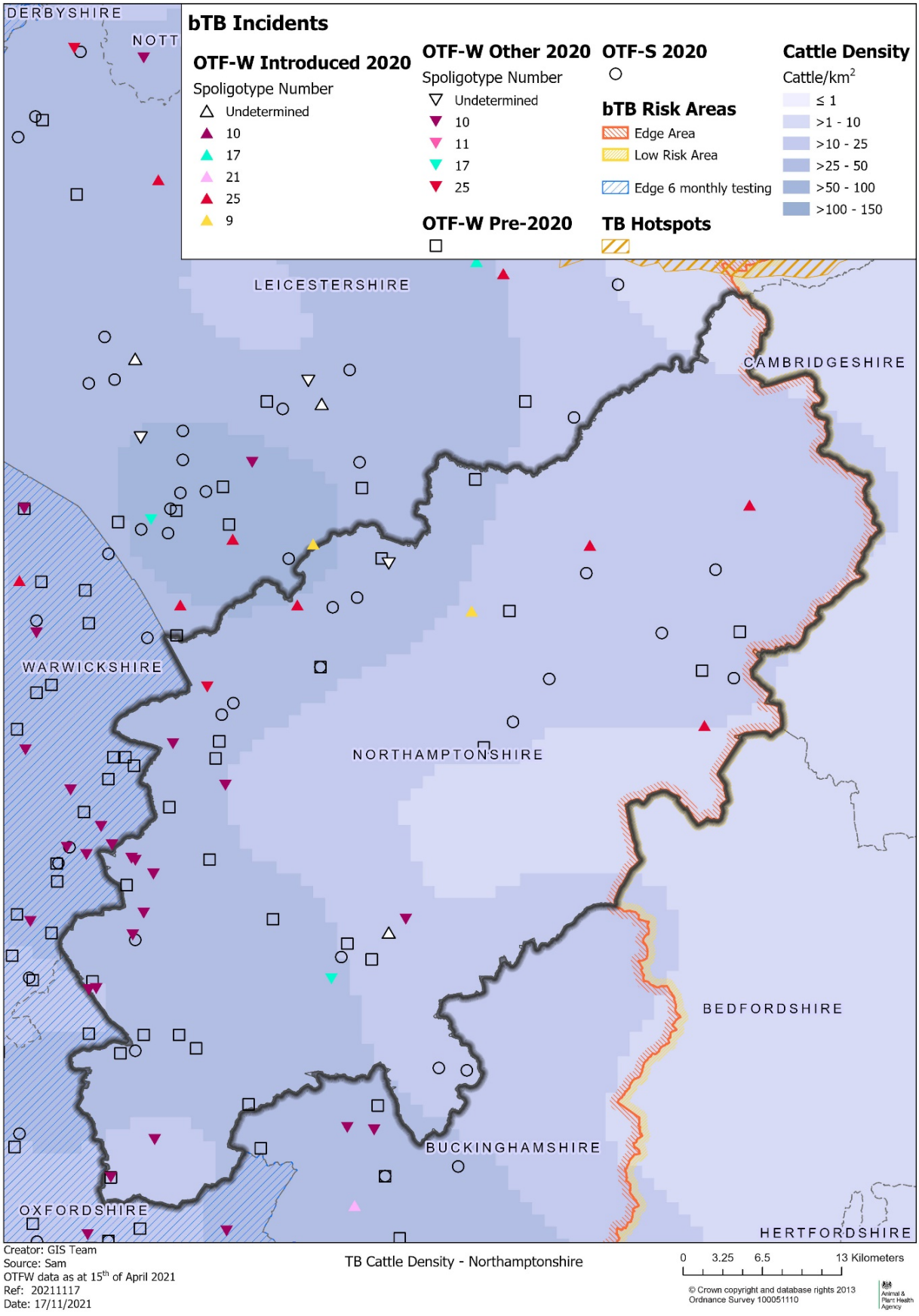

Figure 6: Location of cattle holdings in Northamptonshire with new TB incidents (OTF-W and OTF-S) in 2020 and cattle holdings with pre-2020 OTF-W incidents that were still ongoing at the beginning of 2020, overlaid on a cattle density map. Note 'OTF-W Introduced 2020' refers to OTF-W incidents in which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

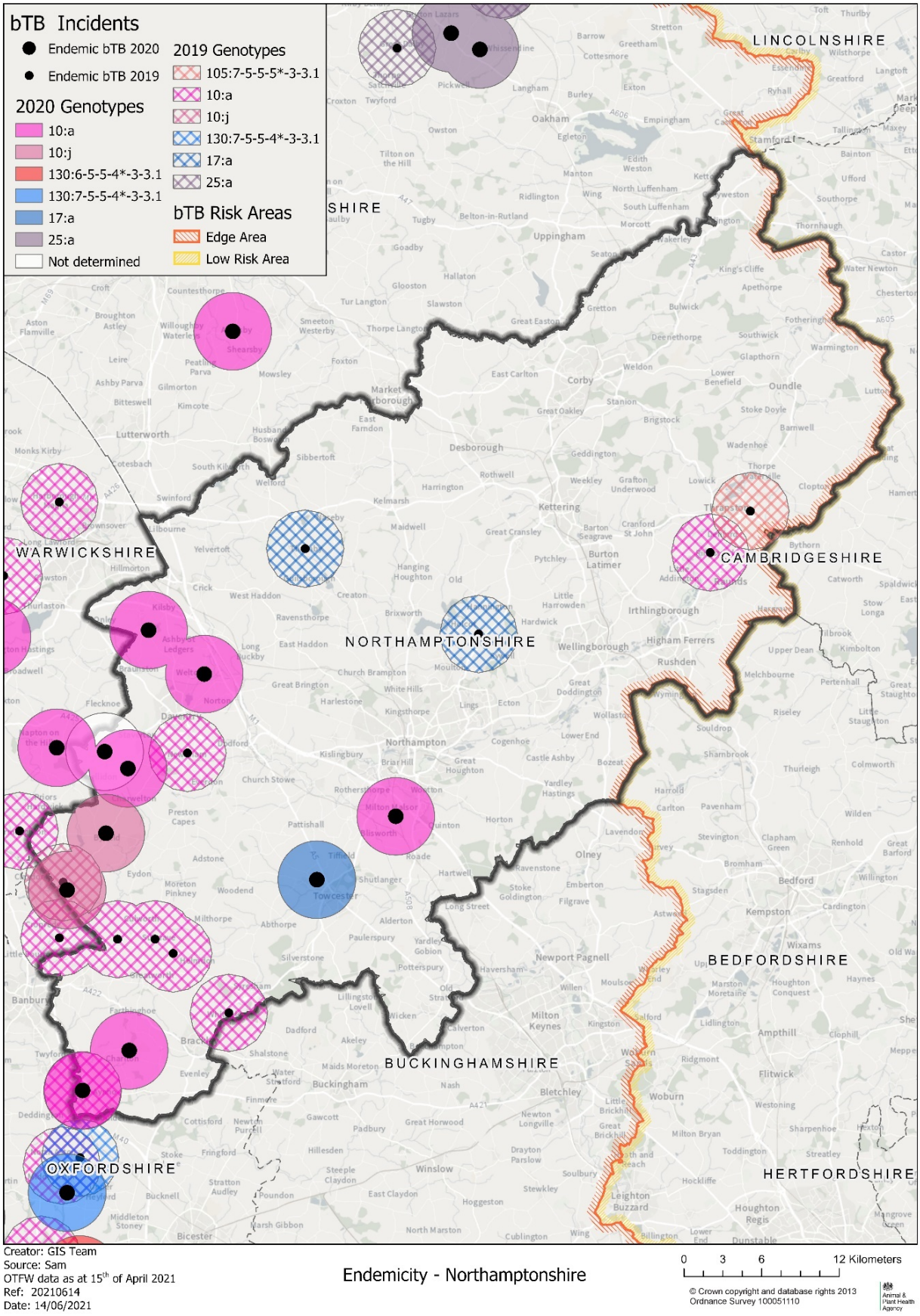

Figure 7: Genotypes of *M. bovis* detected in Northamptonshire between 2019 and 2020, where wildlife sources were attributed with a 75% certainty or above according to the DRF calculation, as an indication of local *M. bovis* reservoir in wildlife populations (OTF-W incidents only).

There is increasing, albeit anecdotal, evidence of closure and subsequent relocation of badger setts along HS2 railway line works (from Boddingdon parish to Whitefield). Concurrently, there is strong eidemiological evidence of transmission pathways relating to infected badgers in this specific area.

In 2019, five of the eight OTF-W incidents west of the M1 motorway were located close to HS2 works (Figure 7), with all five having infected badgers as most likely risk pathway. Four of these incidents had matching genotype of *M. bovis* (10:a) and the fifth had the closely related 10:j.Two of these five incidents occurred in herds with no previous TB history.

An increased number of incidents was seen in 2020 near the border with Leicestershire. Two of the five incidents detected there were due to introduced sources. The remaining three incidents were attributed to infected badgers.

The lack of genetic information, however, increased the degree of uncertainty in the assessments. This is an area which requires close monitoring for early detection of signs of endemic infection.

An important difference from previous reporting period is the eastward scatter of infection along the A14 and up to the Cambridgeshire border. Of particular concern is an area between Thrapston and Oundle where since 2018, albeit low in numbers, new incidents continue to appear.

The OTF-S incidents detected in this area in 2020 (Figure 6) were attributed to infected badgers with risk pathways based on anecdotal evidence only, due to the lack of genetic information. It is of note, however, that there have been historic OTF-W incidents in the locality (Figure 7).

It is perceivable that spill over events from cattle to badgers may have occurred in the past, with the reverse spill over events observed in 2020. The low cattle and cattle herd density in the area may lead to lower frequency interactions between livestock and wildlife and obscure disease dynamics. This is particularly important due to the proximity of this region to LRA counties (Cambridgeshire and Bedfordshire).

Other characteristics of TB incidents

Incidents by herd type

Similar to previous years the majority of incidents (both OTF-S and OTF-W) occurred in beef suckler herds (57%, 13 out of 21 of the OTF-W incidents). This is consistent with this herd type being the predominant cattle enterprise in the county. The number of incidents in dairy herds has reduced by half (n=2) compared to 2019 (Figure 8). The single dairy herd OTF-S incident was the third occurrence in a herd affected twice in 2019 by OTF-S incidents. The single dairy herd OTF-W incident occurred on a farm which was part of the same dairy business, which also suffered an OTF-W incident in 2019.

The positive correlation between herd size and the likelihood of experiencing a TB incident is largely applicable in Northamptonshire. Herds with 351 to 500 cattle were almost three times more likely (29.4%, 5 out of 17) to experience a TB incident compared with those having 51-100 (10.9%, 11 out of 101).

In herds with fewer than 50 cattle, only 3% (7 out of 232) had TB incidents. Consistent with this trend, 18.9% (7 out of 37) of the herds with 201 to 350 cattle were affected.

However, medium-sized herds with 101-200 cattle saw a reduction in the number of incidents from 12% in 2019 to 5.8% (5 out of 85) in 2020. Similarly, the largest cattle herds were less affected in 2020 with 16% (2 out of 12) as opposed to 36% (5 out of14) in 2019.

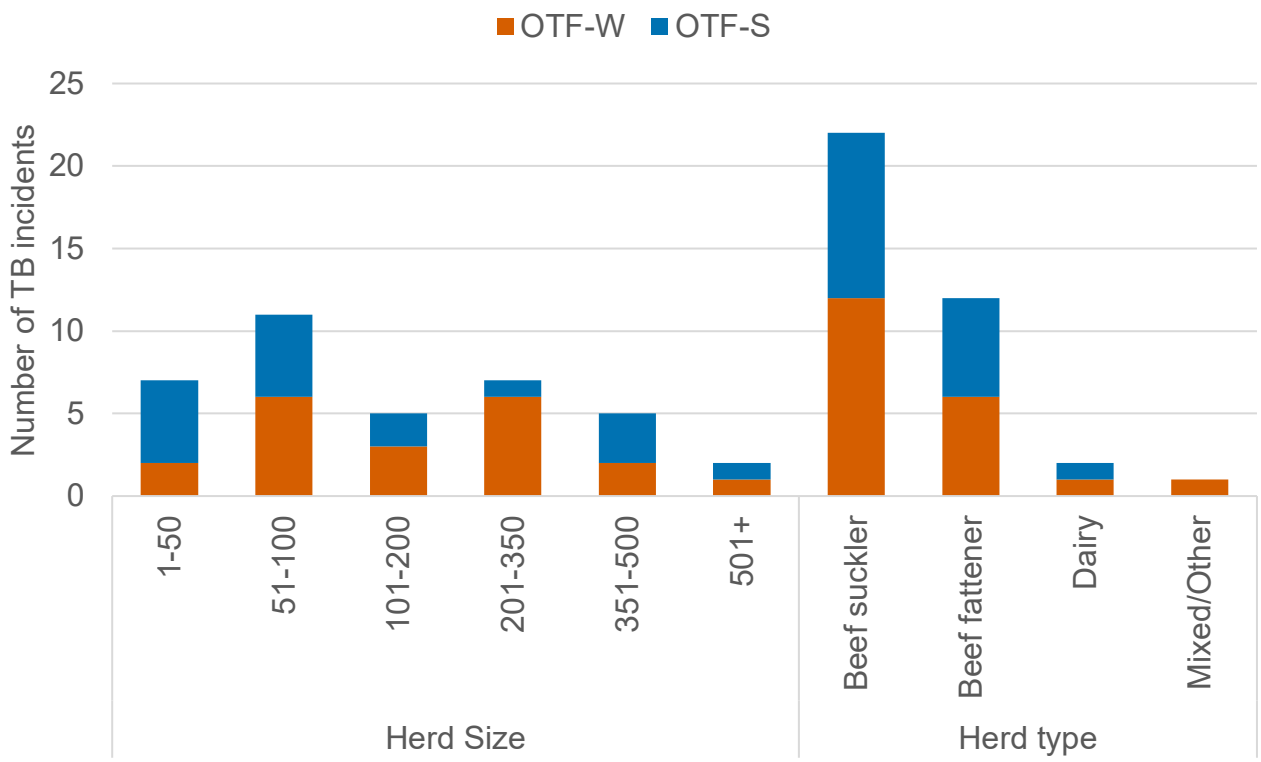

Figure 8: Number of TB incidents (OTF-W and OTF-S) in Northamptonshire in 2020, by cattle herd size and type.

Incidents by month of disclosure

In 2020, a single peak was observed in the last quarter of the year with 37% (14 out of 37) of all new incidents detected in the span of two months, October and November, with no incidents detected in December (Figure 9).

A large proportion (42%, 9 out of 21) of the OTF-W incidents were detected in that same period, which is likely to cause further increase in disease burden in 2021.

Of the 14 incidents detected in October and November 11 were amongst suckler herds with half of those incidents (n=7) detected at routine annual testing.

These incidents were located in non-endemic and low disease prevalence areas of Northamptonshire.

The nine incidents detected during the summer months (May, June, July, and August) were detected by enhanced surveillance testing such as radial, spread trace or check tests.

This highlights the value of this risk-based approach of disease management, with eight OTF-W incidents detected a few months before these herds would have been due for their routine surveillance testing.

Beef suckler herds predominate in Northamptonshire, with traditional farming practices largely applied whereby cattle are housed over the cold and wet months of the year. Routine TB testing is preferentially conducted at such times to facilitate cattle gathering (Figure 10).

This has been historically correlated with the timing of peaks in incident disclosure in the last quarter of the year, which is often related to detection of infection potentially acquired during summer grazing.

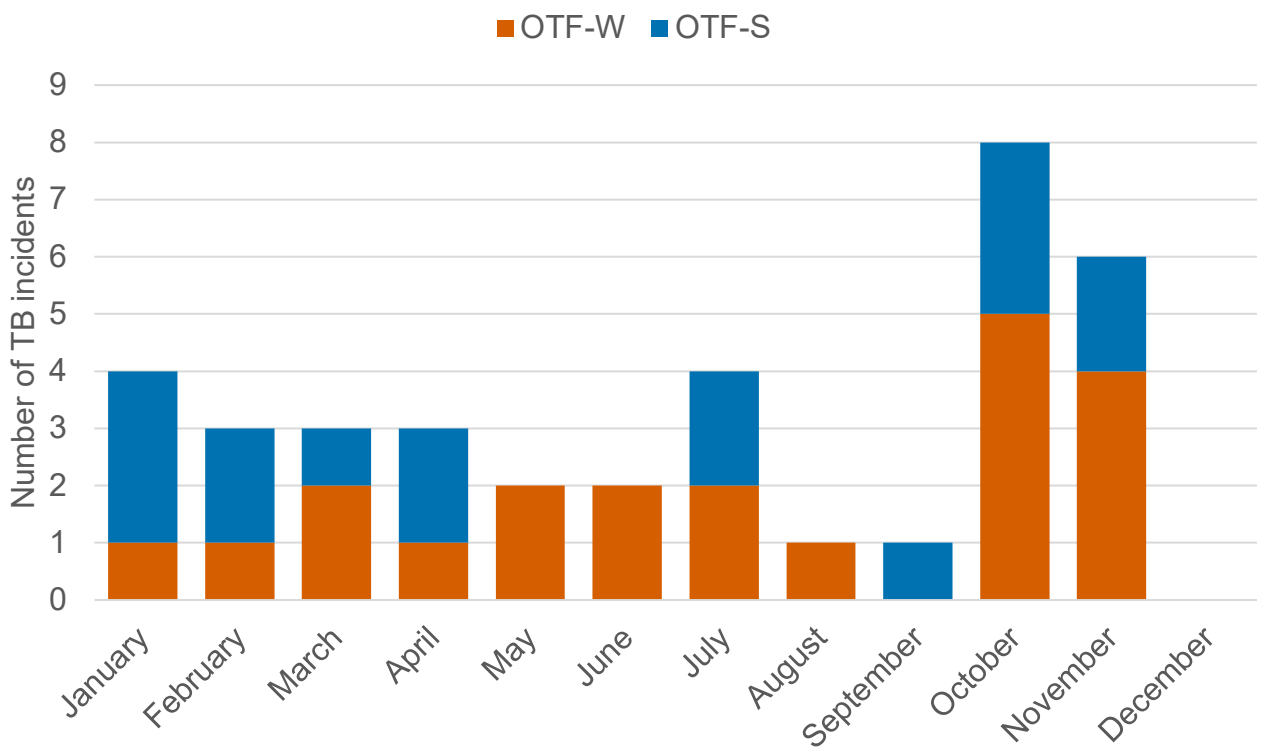

Figure 9: Number of TB incidents (OTF-W and OTF-S) in Northamptonshire in 2020, by month of disclosure.

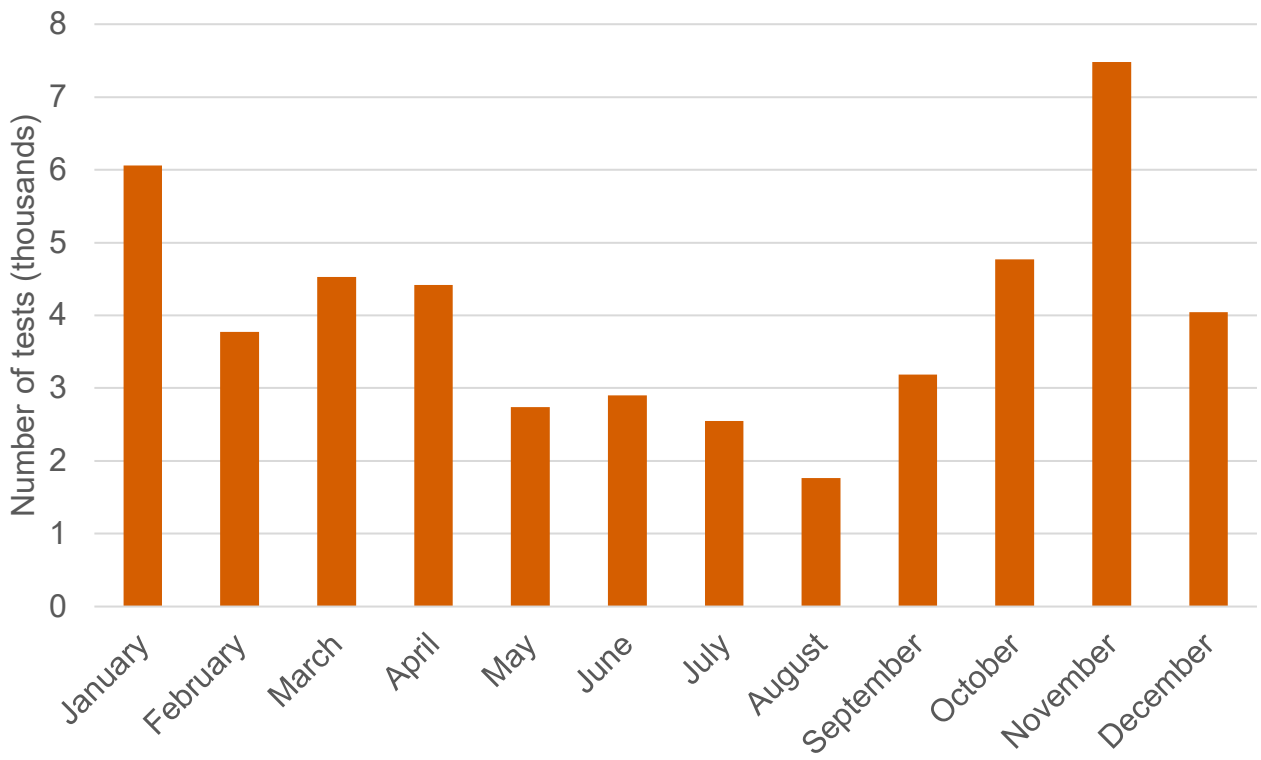

Figure 10: Number of tests undertaken in OTF herds in Northamptonshire in 2020, by month.

Duration of incidents

The usual length of an incident in Northamptonshire is between 151 and 240 days, which accounts for restricted herds undergoing at least two short interval tests, minimum 60 days apart, and time elapsing for reactor removal.

In 2020, over half of the incidents (21 out of 37) fell into that category (Figure 11) indicating that their resolution was achieved without significant complications.

As expected, OTF-W incidents lasted slightly longer than OTF-S incidents, with a median duration of 190 and 171 days respectively. This is mainly due to compulsory IFN-γ testing in OTF-W incidents.

There was one OTF-S persistent incident (with duration exceeding 551 days) in 2020. The delayed removal of TB restrictions in this herd was entirely caused by cattle ID discrepancies impeding the verification that all cattle in the herd had been accounted for and tested.

The required TB incident testing for the herd to regain OTF status was completed within the 151 to 240 day timeframe.

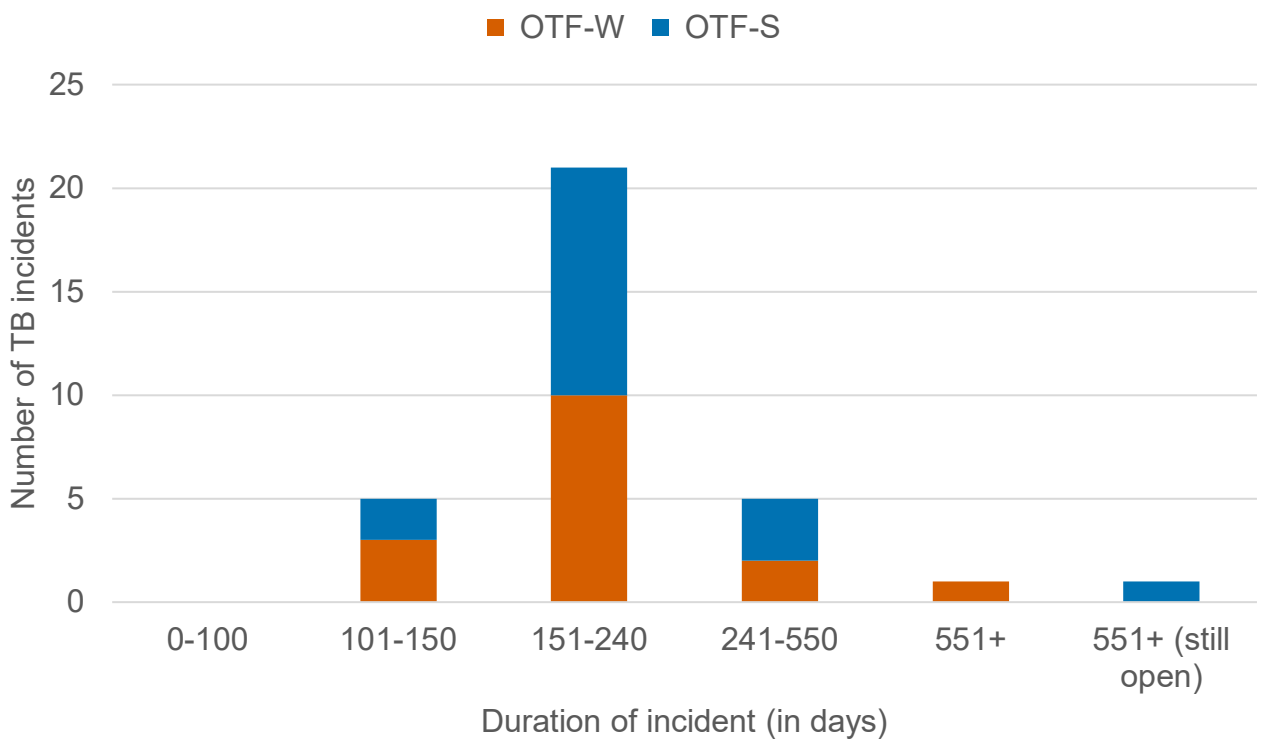

Figure 11: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2020, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2020 in Northamptonshire. Note that Approved Finishing Units (AFUs) have been excluded.

Genotypes associated with TB incidents

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

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

The four different genotypes of *M. bovis* detected in Northamptonshire in 2020 (10:a, 10:j, 17:a and 25:a) were also detected in 2018 and 2019. Of the 21 OTF-W incidents in 2020, 18 were successfully typed and two additional genotypes, 25:b and 9:b were also isolated (Figure 12).

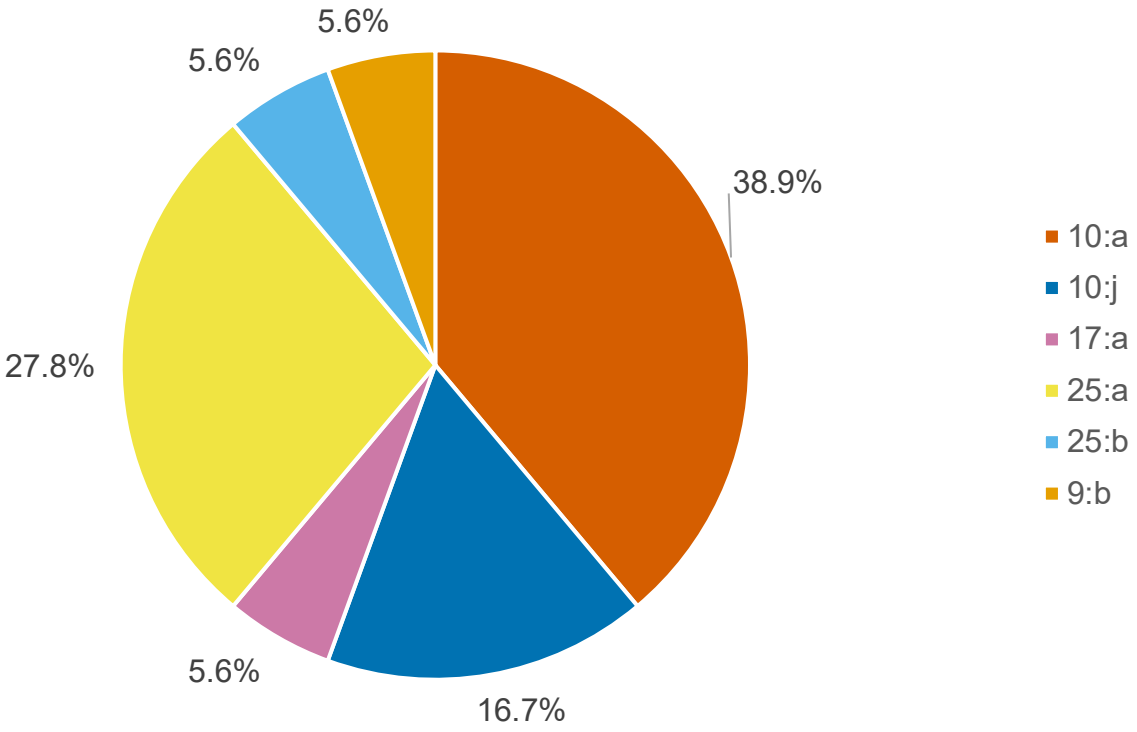

Figure 12: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Northamptonshire that began in 2020 (n=18).

Consistent with findings since 2015, the most commonly detected genotype was 10:a, associated with 39% (7 out of 18) of the OTF-W incidents. This genotype is considered endemic in the west of Northamptonshire (Figure 6 and Figure 7).

Since 2020, there are areas in Northamptonshire near the Warwickshire and Oxfordshire borders where this genotype is now considered to be in its homerange.

The second most frequently identified genotype was 25:a, associated with 28% (5 out of 18) of the OTF-W incidents. This genotype was considered to be introduced via cattle movements.

The third most common genotype is 10:j, accounting for 17% (3 out of 18) of the typed isolates. This genotype is closely related to 10:a and is consistently seen in Northamptonshire, albeit in smaller cluster of incidents.

All 10:j associated incidents in 2020 were in herds which had been infected by the same genotype in 2018 or 2019. In most cases, new exposure from local, presumed infected wildlife was deemed most likely, but residual herd infection could not be ruled out in two of them.

The remainder of the genotypes identified in 2020 were only detected once. The 9:b isolate was considered purchased infection as the homerange for this genotype is in Dyfed (high-risk area of south-west Wales) and was associated with animals being bought from that very region. The other two genotypes of 25:b and 17:a, were believed to have resulted from infected badgers despite being less frequently found in the county.

Unusual TB incidents

There were no unusual TB incidents to report in Northamptonshire in 2020.

Suspected sources, risk pathways and key drivers for TB infection

Key drivers of infection

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

- Infected wildlife
- Inward movements of cattle with undetected infection
- Finishing units (to be distinguished from AFUs) relying on large turnaround of lower cost cattle, usually supplied from areas with higher TB risk.

Established pockets of endemic TB in Northamptonshire (all west of the M1 motorway) have been confirmed by substantial epidemiological and molecular data. Therefore, addressing infection in wildlife reservoirs (mainly badgers) is a necessity.

Whilst farmers' awareness of the importance of biosecurity has increased, the suggested improvement measures are frequently found difficult, costly, and impractical to implement.

Protecting cattle from direct or indirect contamination from badger excreta, especially at pasture, has proven extremely difficult. Neither of the two key control measures listed in Appendix 1 for TB control in wildlife reservoir (licensed badger culling or vaccination) are implemented in Northamptonshire.

Introduction of cattle with undetected infection has always been a risk for any type and size of cattle herd. This is the usual pathway for disease introduction in regions which have been previously TB free.

Most importantly, introduced incidents create opportunities for spill over events from cattle to badgers to occur, thus potentially establishing new areas of endemic TB. The high number of purchased infections in 2020 highlights the need for better control of this risk.

Breeding farms (both dairy and suckler type) are more likely to purchase from other farms rather than via markets, which allows for more pre-movement checks to be made.

For example, enquiries can be made by farmers into the timing and type of last test, and previous TB history by using tools like ibTB to make an informed decision on disease risk.

Finishing farms, however, rely on buying cattle in batches, usually from markets where no assessment of TB risk is possible. Private post-movement testing, whilst considered by breeding farmers, has not been recorded to date in any of the TB-affected herds.

All purchased infections in Northamptonshire in 2020 occurred in finishing or rearing beef farms, both types relying entirely on purchased stock. The volume of animals bought means the use of private post-movement testing on such premises is costly and usually not undertaken.

Implementing compulsory post-movement testing for animals bought from higher risk areas, similarly to rules applied in the LRA, is likely to encourage more responsible sourcing of finishing cattle.

Most importantly, it is also likely to limit the length of time that higher-risk animals spend in the Edge Area either untested or altogether (as fatteners are likely to opt for slaughter within 120 days to avoid the cost of post-movement testing).

Ideally infection, if present, should be detected before an animal has left a holding. Therefore, the introduction of compulsory pre-movement testing in combination with private, high specificity IFN-γ testing for animals intended for breeding could help detect infection at an earlier stage.

This would also address sensitivity drawbacks of the SICCT test, especially when done on small numbers of cattle. This is particularly important for dairy herds where purchases are often from higher-risk areas, which happen to have much larger dairy sectors, as SICCT has been reported to have lower sensitivity in female, dairy and older than four and a half years old cattle (Byrne et al., 2018).

Sources of infection and risk pathways

It can be challenging to retrospectively establish the route of infection for a TB incident herd. APHA aims to complete an epidemiological assessment for all TB incidents in the Edge Area (both OTF-W and OTF-S).

This includes a thorough on-farm investigation and scrutiny of routinely collected data, such as cattle movement records, and the results of molecular analyses where available. This information is captured on the Disease Report Form (DRF).

During the assessment up to three risk pathways of infection are selected for each herd. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd.

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

The most likely source of infection in individual TB incidents

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

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

Based on most likely source of infection from Disease Report Forms (DRF), in 2020 a third (7 out of 21) of all OTF-W incidents were attributed to the introductions of TB-infected cattle ('purchased' origin, Figure 13). This was twice as many as 2019 (15%, 3 out of 16). These introduced incidents were detected mostly in beef fattening farms with one in a rearing farm.

Their spatial distribution appears random and demonstrates that the movement of potentially infected cattle is a risk to any region irrespective of cattle population, cattle herd density or presence of endemic pockets.

For about half of the OTF-W incidents in 2020 (52%, 11 out of 21), infected wildlife was considered the most likely source of infection. No badger carcases were available for surveillance purposes in this county.

Therefore, these conclusions were based on epidemiological assessments of cattle incidents where all potential transmission pathways were considered alongside the pathways that could be confidently excluded.

The local disease picture and, where available, *M. bovis* molecular typing information were also taken into account to improve the accuracy of those assessments.

For one incident, the most likely source of infection was considered residual infection in the herd from a previous recent incident (annotated as 'OTF-W Local cattle' in Figure 13). Another OTF-W incident (with genotype 25:b) had two equally likely sources of infection: infected wildlife and cattle movement, representing concurrent risk pathways occurring.

The movement component related to part of the herd re-located on a temporary holding for summer grazing, whilst the main holding also suffered an incident .

Anecdotal evidence of infected wildlife around both of the related premises was also present. The lack of genetic information on *M. bovis* from the main premises made it difficult to clarify whether the part of the herd at summer grazing was already infected prior to the movement or infection was acquired from local wildlife after the move.

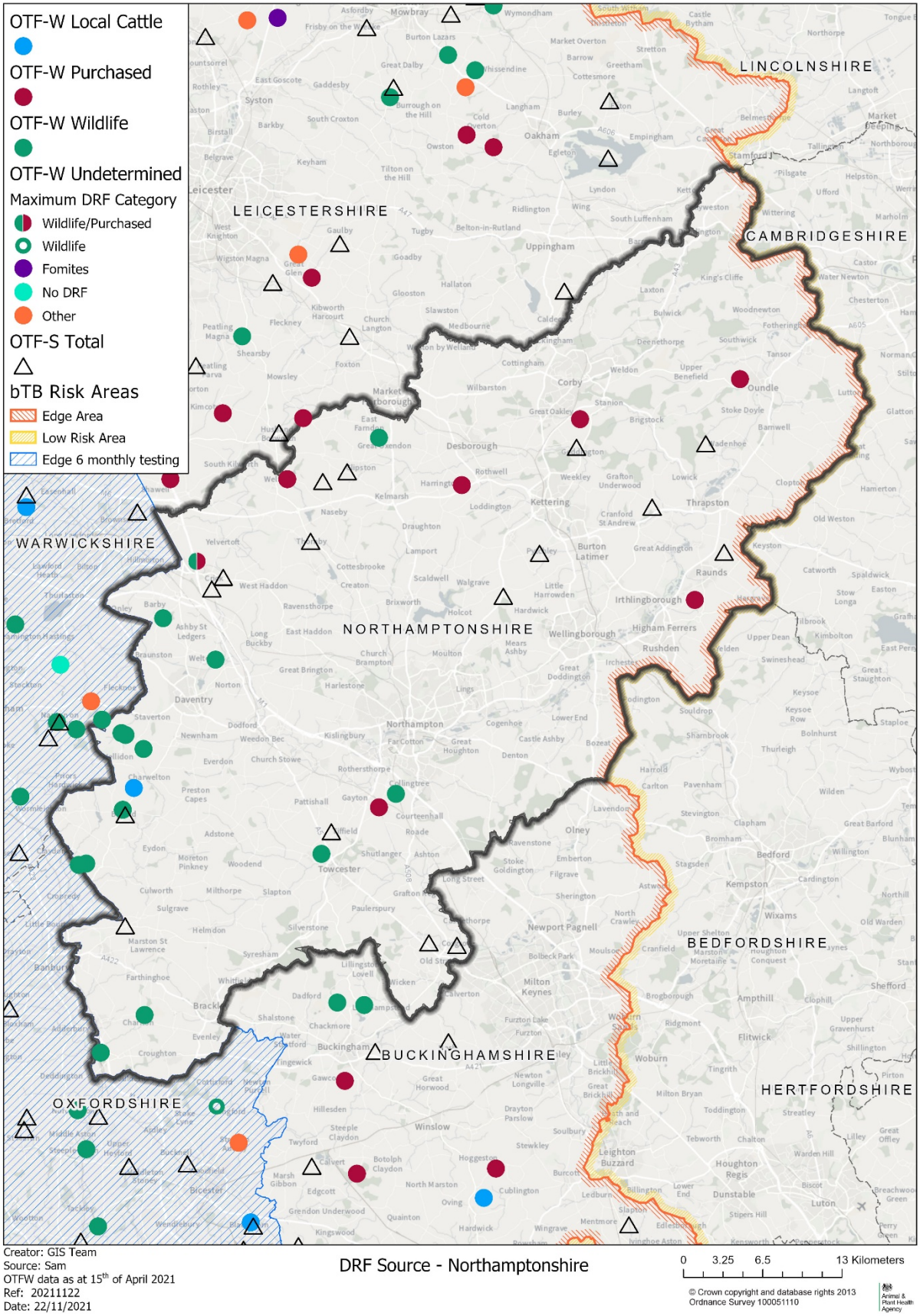

Figure 13: Map of the source of infection pathway recorded with the highest level of certainty, for all TB incidents (OTF-W and OTF-S) in Northamptonshire which started in 2020. Where none of the sources of infection were identified with greater than 50% certainty, the highest ranking source is displayed with an OTF-W undetermined 'maximum DRF category' symbol.

The weighted source of infection at county level

To consider the contribution of all sources of infection within an area, 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 into a herd.

If the overall score for a herd is less than six, then the score is made up to six using the 'Other/Unknown Source' option. Buffering up to six in this way helps to reflect the uncertainty in assessments where only 'likely' or 'possible' sources are identified.

The weight of infection outputs in Appendix 4 are produced by combining the data from multiple herds. This presents the overall proportion of pathways in which each source was identified, weighted by the level of certainty each source caused the introduction of TB. The outputs do not show the proportion of herds where each pathway was identified (this is skewed by the certainty calculation).

Genotyping of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however genotypes are not determined for OTF-S herds. The inclusion of OTF-S herds in these calculations increase the uncertainty in the outputs. As a result, the relative proportions of each risk pathway is very approximate and only broad generalisations should be made from these data. A more detailed description of this methodology is provided in the Explanatory Supplement.

Infected badgers, as a weighted source pathway, contributed to 56% of new OTF-W incidents (Figure 14a) and 24% of new OTF-S incidents (Figure 14b) in Northamptonshire in 2020. This was a reduction from 68% for OTF-W and 37% for OTF-S incidents in 2019. However, overall infected badgers contributed to 56% of all new incidents in 2020 as opposed to 52% in 2019.

The use of this algorithm allows for better representation of the various risks, acknowledging the fact that in many incidents more than one risk pathway is possible (see Table A4 in Appendix 4).

Similar to previous years infected badgers continue to be implicated for the first time in areas of the county with previously very low incidence (Market Harborough near Leicestershire and Oundle near Cambridgeshire). Most of these incidents are TB lesion- and culture-negative (OTF-S), meaning that the degree of uncertainty in determining the source of infection is much higher.

A clear example of this is the high proportion (30%) of the OTF-S incidents in 2020 having an 'Unknown or Other' source of infection. In those cases, there is not enough evidence to support any specific risk pathway.

Inward cattle movements contributed to 36% of the new OTF-W incidents and 31% of the OTF-S incidents. This shows an increase from 2019 (23% OTF-W and 24% OTF-S). Risky purchasing practices are central to this significant driver of disease spread. This is a risk applicable to any size and type of herd, but in 2020 it was mostly seen in fattening units.

Residual cattle infection and infection from contiguous cattle herds (nose to nose contact) have both seen increase in 2020 compared to 2019, especially amongst OTF-S incidents.

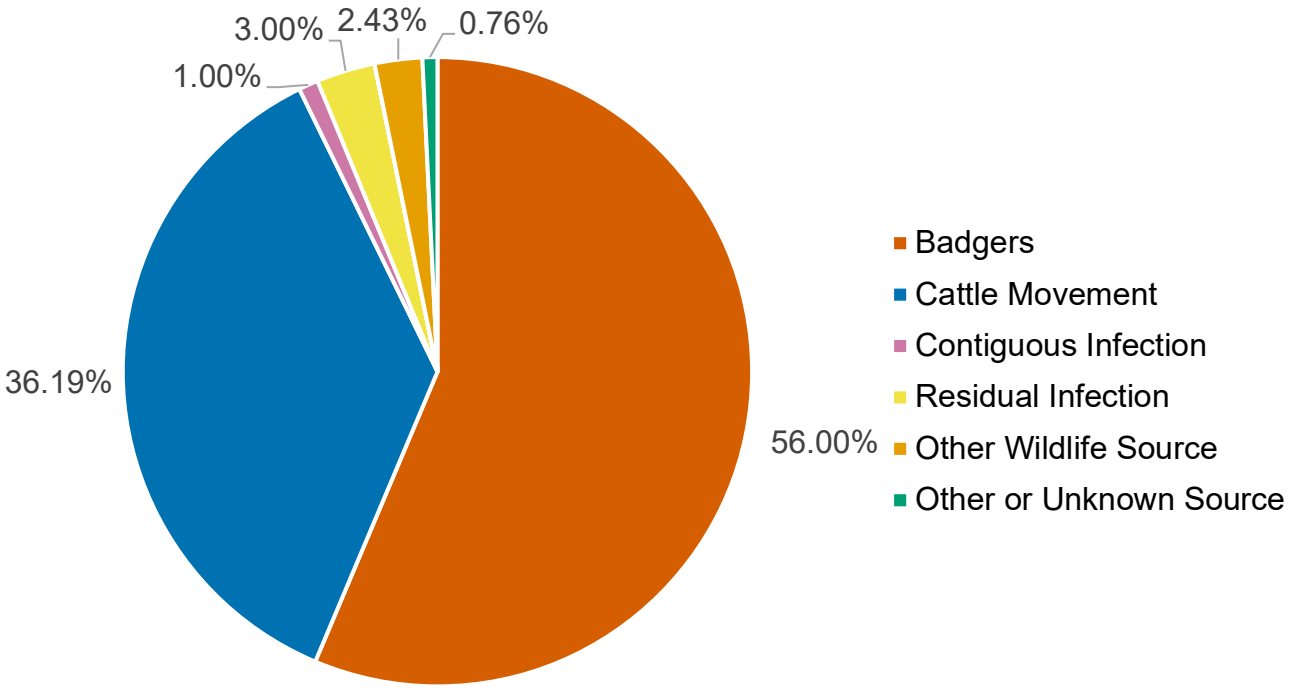

Figure 14a: Summary of the weighted source of infection pathways attributed for OTF-W TB incidents that started in 2020 in Northamptonshire, that had a completed DRF (n=21).

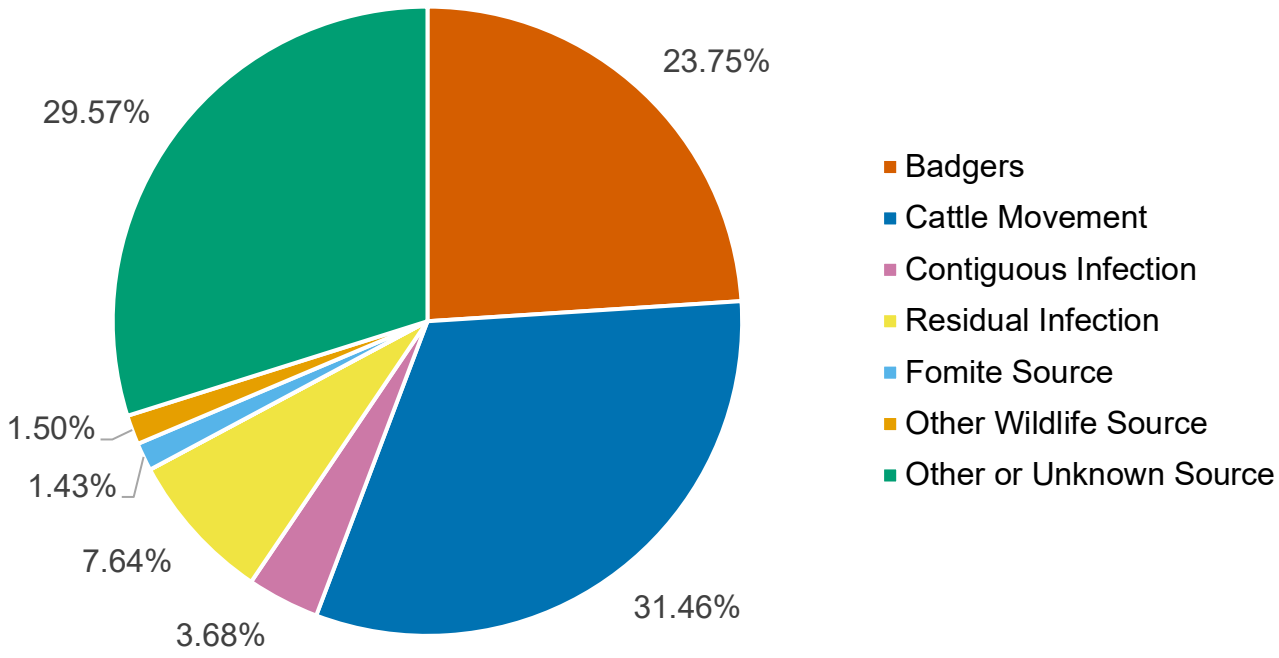

Figure 14b: Summary of the weighted source of infection pathways attributed for OTF-S TB incidents that started in 2020 in Northamptonshire, that had a completed DRF (n=16).

TB in other species

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

Goats

Since one isolate from a goat in 2012, there have been no laboratory confirmed incidents of *M. bovis* infection in any wild or non-bovine animals in Northamptonshire.

Alpacas

In 2020 a single alpaca was identified as an antibody TB test reactor. The alpaca was tested on request by APHA due to the proximity of a cattle herd with an OTF-W incident, as per the existing policy in England. The alpaca had no visible TB-like lesions and *M. bovis* was not isolated from a pool of its lymph nodes.

Detection of TB incidents

In 2020 most incidents were detected by radial (RAD) testing (Figure 15a).

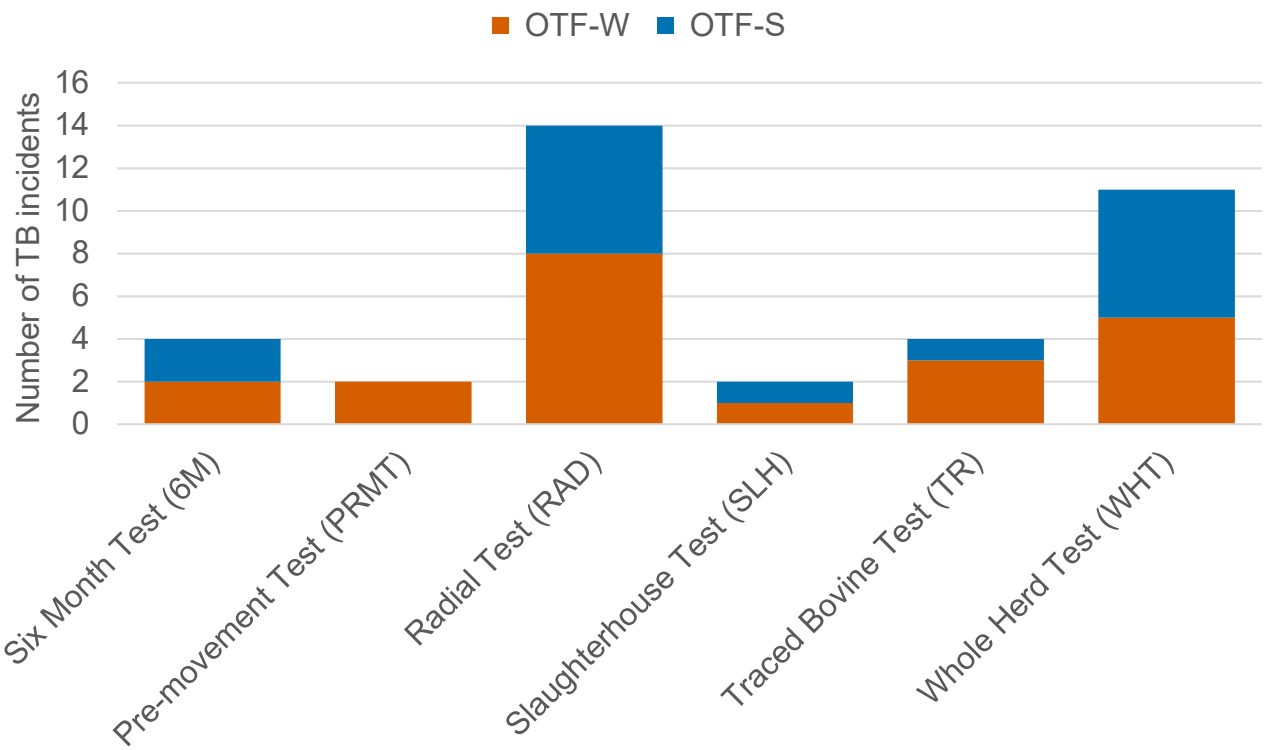

Figure 15a: Number of TB incidents (OTF-W and OTF-S) in Northamptonshire in 2020, disclosed by different surveillance methods.

As shown in Figure 15b, historically the majority of the incidents in Northamptonshire were detected by routine annual surveillance testing (Whole Herd Test, WHT).

In 2018 radial testing (RAD) was introduced as one of the enhanced surveillance measures aimed at more timely detection of potential local lateral spread of disease. This test type detected 38% (14 out of 37) of incidents in 2020, which was similar to 2019 (38%, 13 out of 34), but an increase from 2018 (27%, 8 out of 30).

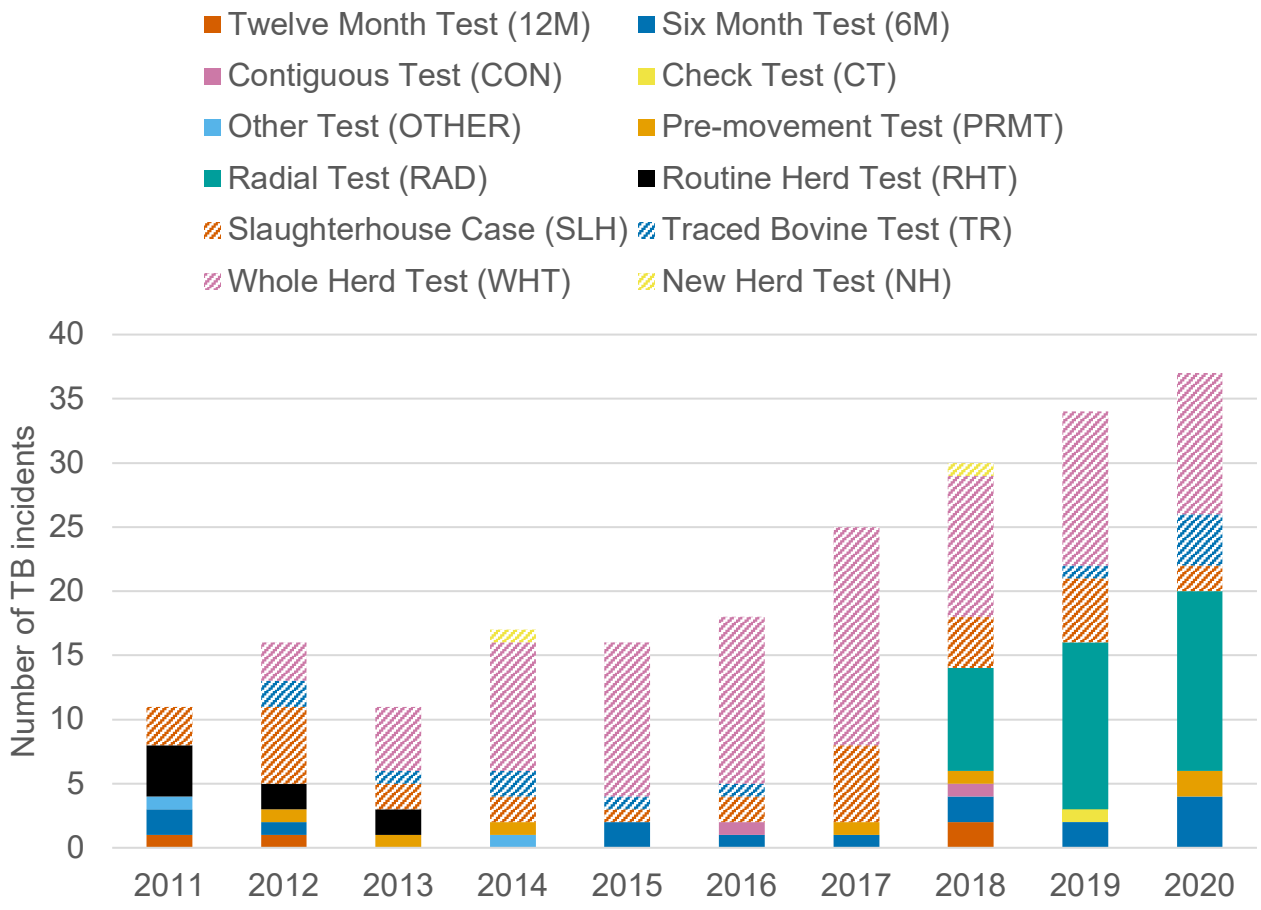

Figure 15b: Number of TB incidents (OTF-W and OTF-S) in Northamptonshire, 2011 to 2020 disclosed by different surveillance methods by year.

Six month (6M) post-incident tests and forward trace tests (TR) are the other two types of enhanced surveillance tests. Those detected 22% (8 out of 37) of the incidents in 2020.

Comparable to previous years, this data provides evidence of the efficacy of enhanced control measures applied using risk-based approach, which allows timely detection of residual, recently introduced or re-introduced infection.

Compulsory pre-movement testing (PRMT) detected two OTF-W incidents in 2020, helping to prevent disease spread to other cattle herds via cattle movements. Only two incidents were detected by slaughterhouse surveillance (slaughterhouse case notifications at routine post-mortem meat inspection, SLH) in 2020, a reduction from 2019 (n=5) and 2018 (n=3). The lesions seen in both of these incidents were suggestive of mycobacterial infection on histological exam but *M. bovis* could not be isolated in either of them.

In both herds however, further infected animals were detected as skin test reactors at the check tests scheduled after the slaughterhouse notification. One of the two herds was a dairy herd with recurrent TB incidents since 2019. SLH cases in AFUs have been excluded from incidence reporting. There were four in 2020, with one culture positive. (Appendix 3, Table A4).

Figure 16 shows the number of new OTF-W and OTF-S incidents in 2020, that had experienced an OTF-W incident in the previous three years. It excludes new incidents that were also on restrictions in the first four or more months of 2020 due to an incident that started before 2020. The Explanatory Supplement (see Section 4.3), provides more details on the reporting of recurrent TB incidents.

Consistent with findings from previous years, the majority of the new incidents in 2020 occurred in herds with no OTF-W incidents in the preceding three year period (30 out of 37, Figure 16). However, there is a general increase in the number of OTF-W incidents with previous TB history from a single case in 2018, to four in 2019 and five in 2020.

Six of the seven incidents with previous TB history had new disease introduction from infected badgers identified as the most likely risk pathway. However, residual infection could not be excluded as a possibility in three of the six. The other incident was caused by continous practice of high-risk purchases.

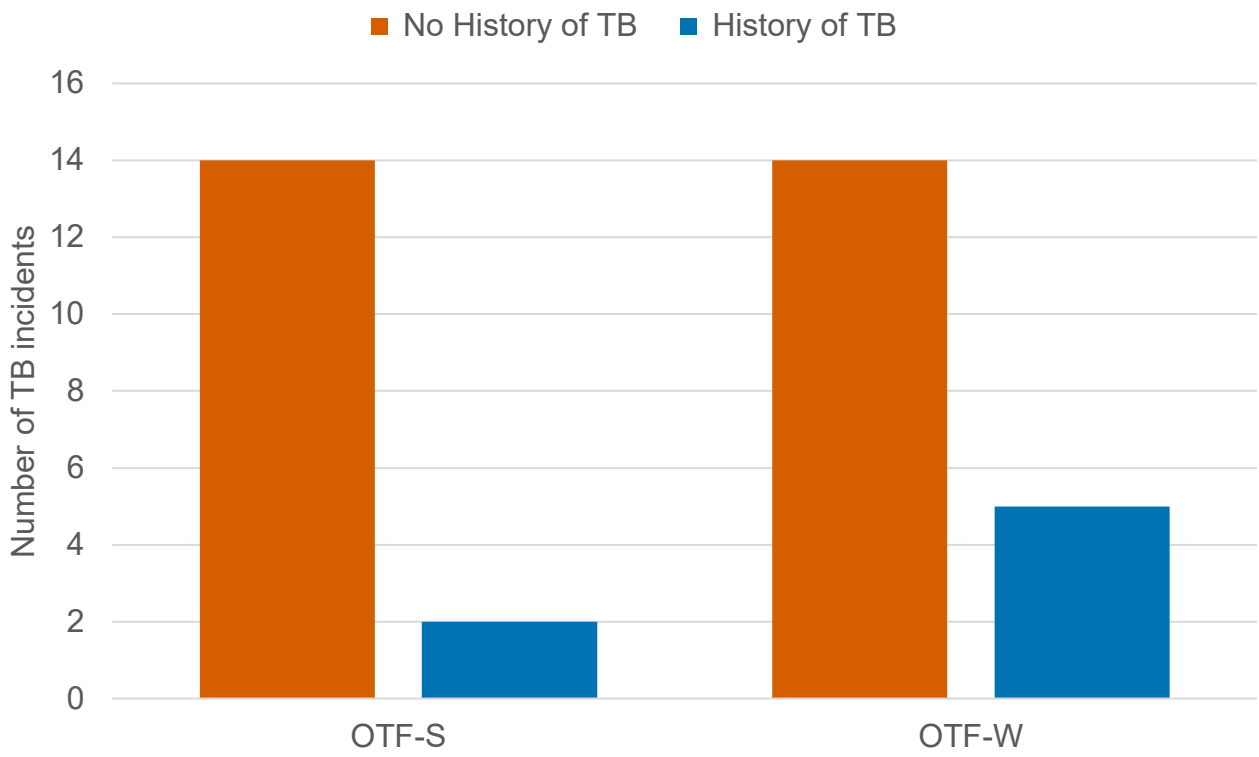

Figure 16: Number of herds with a TB incident (OTF-W and OTF-S) in Northamptonshire in 2020, with a history of TB (herds that experienced an OTF-W incident in the previous three years), and holdings without a history of TB in the previous three years.

Skin test reactors and interferon gamma test positive animals removed

The total number of reactors (159) removed in 2020 decreased compared to 2019 (248) when Northamptonshire saw its highest number since 2011 (Figure 17 and Table A4 in Appendix 3). This is also reflected by the reduction in the number of reactors per incident from 7.3 in 2019 to 2.2 in 2020, and the reactors per 1,000 animal tests from 2.8 in 2019 to 2.2 in 2020.

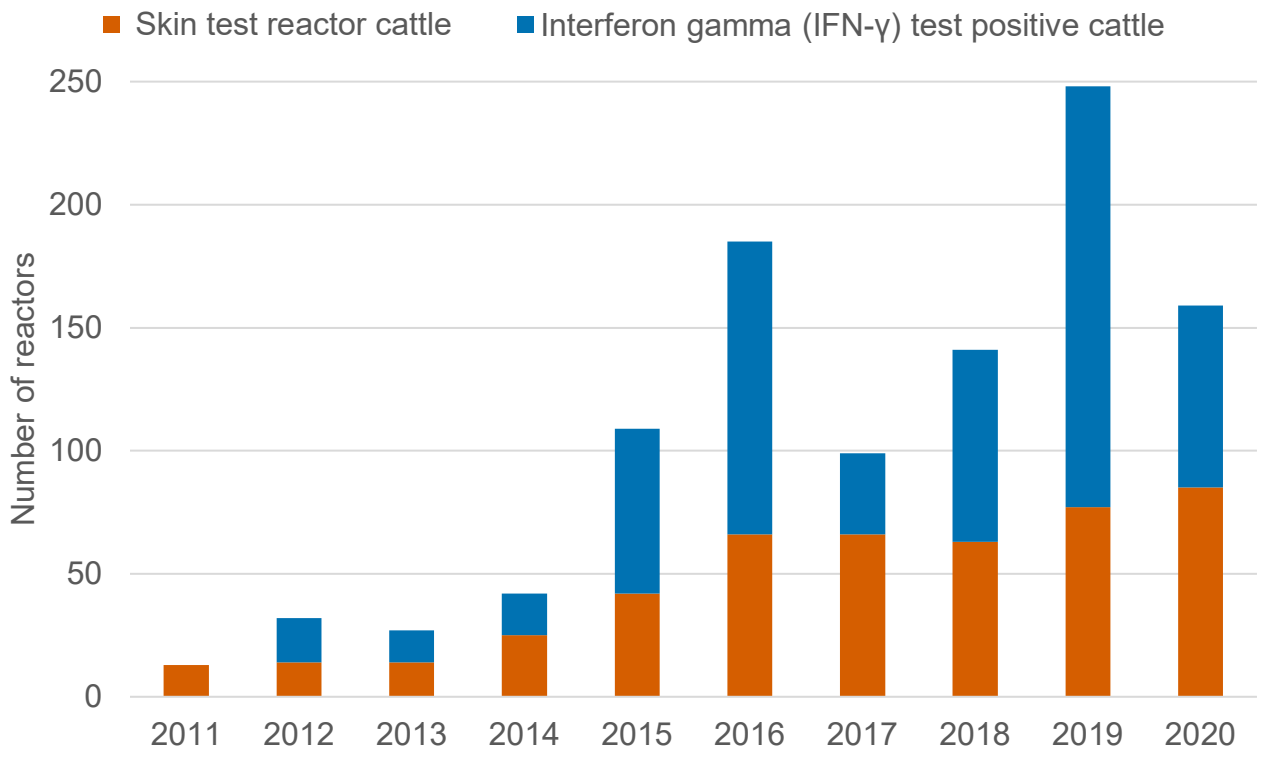

Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Northamptonshire, 2011 to 2020.

This change is driven by the significantly decreased number of IFN-γ test positive animals detected, which nearly halved since 2019 (a decrease from 171 to 74). However, the number of animals detected in 2019 was unusually high and the number seen in 2020 is more in line with what is normally seen in Northamptonshire.

An incident which started in 2019 involving part of a very large dairy herd went through three rounds of IFN-γ testing. The second and third rounds took place in 2020 and were responsible for 40% (30 out of 74) of the IFN-γ test positive animals removed in 2020. This same farm also accounted for 22% (19 out of 85) of the skin reactors removed in 2020. It can therefore be concluded that overall skin test reactors numbers remain relatively steady in the face of increasing number of incidents.

Similarly, to 2018, in 2020 almost half of the OTF-W incidents were detected in the last quarter of the year (see Figure 9). This means that testing for these incidents will be conducted in 2021 and any reactors associated with them are not accounted for in 2020.

Therefore, the increased number of reactors in 2019 and its decrease in 2020 needs to be interpreted in line with the timing of incidents detected.

The number of herds exempted from IFN-γ testing was comparable for both 2019 (two whole herd and three partial herd exemptions) and 2020 (two whole herd, one partial herd exemption and one herd naturally depopulated before any testing was conducted). Therefore, this has not played a role in the change of number of reactors nor has COVID-19 epidemic which had not affected incident-associated testing in Northamptonshire in 2020.

Summary of risks to Northamptonshire

Northamptonshire is surrounded by Edge Area counties to the west, south and north, and LRA counties to the east. Northamptonshire's areas with higher cattle densities border the Edge Area counties of Warwickshire and Oxfordshire, both of which are subject to six-monthly surveillance testing and have much higher levels of TB incidence and prevalence.

The geographical distribution of TB incidents in Northamptonshire is strongly supportive of the hypothesis that there is disease ingress into the county from both Warwickshire and Oxfordshire. Fragmented holdings with rented grazing land are common. This extends farm boundaries over very large areas and potentially into those considered endemic areas.

With cattle farming concentrated in west Northamptonshire, the two most utilised livestock markets are those in Warwickshire and Oxfordshire (Rugby and Thame market respectively), instead of Thrapston market located in east Northamptonshire where cattle density is low. Thrapston market, albeit being closer to LRA counties, is largely used by cattle dealers from Cheshire (Edge Area).

Therefore, Thrapston market is becoming an outlet for cattle sourced from Cheshire, Shropshire (HRA), Staffordshire (HRA), and high-risk areas of Wales, all of which have a higher TB risk than Northamptonshire. The risk of moving cattle with undetected infection into the county from those areas is always present and might have facilitated disease spread into local wildlife in the past.

Northamptonshire borders the annual testing Edge Area counties of Buckinghamshire and Leicestershire, with little evidence so far for any infection expansion from either.

The LRA counties surrounding Northamptonshire are Bedfordshire and Cambridgeshire. Neither of these counties are currently seen as a threat in terms of TB infection.

There are no HRA counties adjacent to Northamptonshire. Therefore, the risk from the HRA is driven mainly through purchased cattle, with *M. bovis* genotypes prevalent in the HRA found in purchased animals.

First signs of plausible evidence that the movement of cattle from HRA has resulted in lateral spread within the county are the newly formed clusters of incidents in Market Harborough (near the Leicestershire border) and Oundle (near the Cambridgeshire border).

All OTF-W incidents with genotype 25:a in 2020 were caused by animals which had been born or resided in Staffordshire or Cheshire (where genotype 25:a predominates), moved through Market Drayton (Shropshire) market or moved through Thrapston market via dealers based in Cheshire. Disease control measures may not have been robust enough and may have missed previous infections.

This has potentially allowed opportunities for events of spill over of infection from cattle to local wildlife to have taken place. In the Market Harborough cluster, the first incident with 25:a indicating potential wildlife infection was detected in 2018.

Summary of risks from Northamptonshire to surrounding areas

The TB risk to the adjacent LRA counties (Cambridgeshire and Bedfordshire) has increased since the last reporting period.

Whilst the endemic TB front in Northamptonshire is geographically distant to those counties, with large areas of low cattle density between Northamptonshire and the LRA counties, a pocket of increased numbers of incidents near those borders has formed. In 2020 a purchased infection in a fattening herd near Bedfordshire was found.

Due to the limited number of investigations conducted in this part of Northamptonshire, it remains largely unknown how many farms are using grazing land extending into Cambridgeshire or Bedfordshire. Both Cambridgeshire and Bedfordshire have had very few incidents over the last three years with all of those being geographically distant from Northamptonshire.

The TB risk to the neighbouring Warwickshire and Oxfordshire Edge Area counties is probably equal to the risk presented by them to Northamptonshire. This is due to potential shared wildlife populations (badgers and deer) in the border parishes.

There is a limited risk posed by cattle movement to Warwickshire and Oxfordshire from Northamptonshire as the latter has lower disease prevalence and the cattle flow tends to be towards Northamptonshire not the opposite.

The risk to Leicestershire from Northamptonshire has risen due to the cluster of incidents in Market Harborough area. This is believed to has been initially driven by purchased cattle from HRA and higher-risk Edge Area counties. Evidence at present is circumstantial only, but it is possible that repeated introduced infections may have created a small endemic pocket due to previously undetected spill over of infection from cattle to wildlife.

This may in turn further expand into Leicestershire via wildlife, but there is no evidence of this yet. Hotspot 23 (HS23, Figure 6) affects the north-eastern part of Leicestershire and while genotype 25:a is predominant in this area, none of the HS23 incidents have been linked with 25:a related incidents in Northamptonshire.

There is no evidence at the moment suggesting risk to Buckinghamshire associated with disease being moved in either direction via cattle or wildlife.

Assessment of effectiveness of controls and forward look

Effectiveness of controls

Most of the incidents over the last few years have been detected by enhanced surveillance measures proving their usefulness and necessity in disease control. They have performed well in terms of detecting and therefore removing infection at an earlier stage, but they are only tackling TB in the cattle population.

With an ever rising number of incidents and an increasing proportion of infections caused by new exposure events from infected wildlife, as well as an increased number of purchased infections, there is need of additional measures to be introduced to reduce the risks from these sources.

Over the last few years APHA, in collaboration with the Northamptonshire TB Eradication Group, alongside accessible educational material provided by Defra and other stakeholders, has increased knowledge, and understanding of the disease among the farming community. This was a vital step in changing farmers' behaviour and encouraging them to increase on-farm biosecurity.

Unfortunately, the COVID-19 pandemic has meant regular meetings have stopped, which has reduced this close collaboration between different stakeholders. For example, this has prevented further work on the establishment of a badger cull area.

The COVID-19 pandemic also led to the postponement of the full rollout of six-monthly surveillance testing throughout the HRA of England (from where the purchased incidents in Northamptonshire in 2020 originated).

This will be an important step in detecting disease earlier and stopping further spread. More focus is needed in communicating to farmers the importance of safe cattle trade, and encouraging farmers to invest in additional testing, for example, post-movement testing.

Forward look

The number of new incidents and the herd incidence rate in Northamptonshire have been steadily increasing since 2013 despite continuous adaptation and enhancement of the disease control measures in cattle.

The OTF-W annual incidence (per 100 OTF herds tested) in Northamptonshire in 2020 was 4.3%, which is a further increase on 2019 (3.3%). This not only means Northamptonshire was unable to meet the short-term objective of less than 2% (Appendix 1), but also makes it highly unlikely Northamptonshire to be able to achieve OTF status by 2025.

Appendices

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

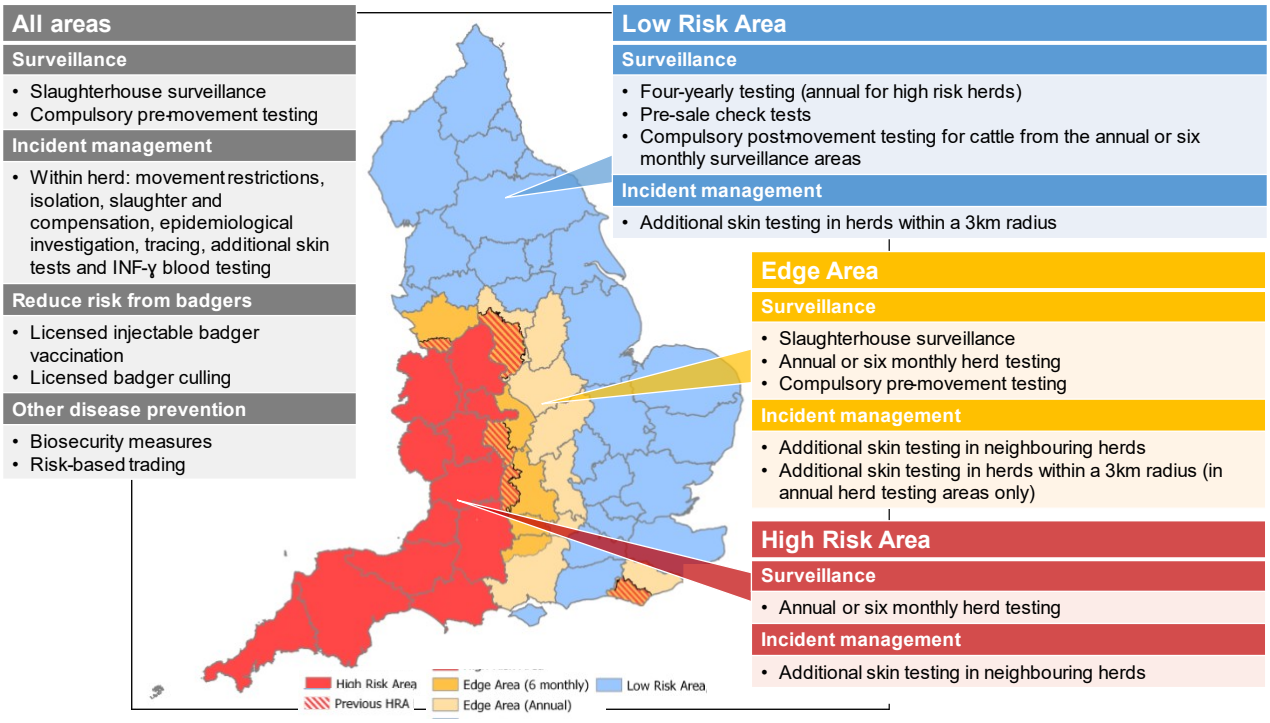

Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the UK government's Strategy for Achieving Officially Tuberculosis-Free Status for England. The map is described in more detail in the Explanatory Supplement for England 2020.

Short to medium term:

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

Longer term:

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

For more information about the governments approach to controlling TB, visit the strategy for achieving Officially Bovine Tuberculosis Free status for England, published in 2014 and independently reviewed in 2018, see:

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

Key Control Measures

Surveillance:

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

Management of cases ('incidents'):

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

TB controls in the wildlife reservoir (badgers):

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

Other measures:

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

Summary of enhanced TB control measures in Northamptonshire

Edge Area testing policy

- No control measures in addition to those listed above have been applied in Northamptonshire in 2020.
- Active case management by APHA has allowed for nearly 600 cattle across three different holdings to be exempted from compulsory IFN-γ testing due to being

considered low risk. Two of these three holdings had complete herd exemptions, while the remaining one had partial herd exemption.

- Incidents can have a significant financial impact on the farmers due to loss of production and cost of lost stock replacement. Some holdings have challenges with obtaining grazing land away from the holding due to TB restrictions and facilitating risk assessed movement of the stock without compromising animal welfare is often needed. This in turn requires much greater input from APHA in incident management (risk assessments, processing of licence applications and logistics around removal of large number of reactors).
- There was no discretionary use of the IFN-γ test in OTF-S incidents in Northamptonshire in 2020. One beef fattener herd achieved resolution through complete natural herd depopulation without any skin and IFN-γ testing being conducted.
- Radial testing has proven to be an effective targeted surveillance measure, detecting 38% (14 out of 37) of the new incidents in Northamptonshire in 2020. The majority of those radial tests (8 out of 14) were the second round of this enhanced testing (deployed six months after the previous test). Without this enhanced surveillance testing, these incidents may have remained undetected for a further six months. This allowed for prompt infection control measures to be deployed in infected herds, prevented movement of infected cattle and potentially limited spill over of infection into the local wildlife population.

Other testing measures

- There was an increase in the number of overdue TB tests in Northamptonshire in 2020. Due to COVID-19, referral to the Rural Payments Agency (RPA) of keepers of herds with overdue skin tests for reduction of single farm payment was temporarily suspended, which removed the pressure of timely completion of testing. No overdue tests, however, were associated with the detection of new TB incidents in 2020 and no such tests were in the endemic areas of the county. No involvement from the Local Authority was required in 2020 to enforce TB control measures and all overdue tests were completed by the end of the reporting period .

Other control measures

- The Northamptonshire TB Eradication Group was established in 2017 with the support of local National Farmers Union. The group has provided an opportunity for industry, private veterinary surgeons and APHA representatives to meet, discuss and work together towards reducing TB incidence in the county. No such meetings, however, took place in 2020 due to COVID-19.
- A project funded by the EU through the Rural Development Programme for England, called the TB Advisory Service (TBAS), was introduced at the end of 2017. This service offers one-to-one on-farm advice visits, where trained advisors provide bespoke recommendations to reduce the risk of TB incursions in herds that are currently clear, whilst discussing trading options and measures to prevent

repeated reinfection for farms that are currently under TB restrictions. Awareness of the existence of this service has increased through industry engagement at meetings and promotion of the service by APHA.

- Quality assurance of skin testing delivered by official veterinarians actively took place in 2018 and 2019 across the Edge Area. Fewer inspections were completed in 2020 due to COVID-19. The aim is to ensure that the skin test is consistently performed to the required standards.

Appendix 2: Cattle industry in Northamptonshire

Table A2.1: Number of cattle premises by size band in Northamptonshire at 1 January 2020. (RADAR data)

Size of herds	Un*	1-50	51-100	101-200	201-350	351-500	501+	Total number of herds	Mean herd size	Median herd size
Number of herds	6	232	101	85	37	17	12	490	99	55

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of cattle	41,142 (85%)	5,849 (12%)	1,348 (2%)	1 (less than 0.01%)	48,340

Appendix 3: Summary of headline cattle TB statistics

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

Herd-level statistics	2018	2019	2020
(a) Total number of cattle herds live on Sam at the end of the reporting period	587	595	598
(b) Total number of whole herd skin tests carried out at any time in the period	623	721	612
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	498	477	459
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of Notice Prohibiting the Movement of Bovine Animals (TB02) restrictions)	540	552	540
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	560	571	570
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	30	34	37
• OTF-S	15	18	17
• OTF-W	15	16	20
(g) Of the OTF-W herd incidents:			
• How many can be considered the result of movement, purchase or contact from or with an existing incident based on current evidence?	6	3	8

Herd-level statistics	2018	2019	2020
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	4	4	5
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (such as, forward and back-tracings, contiguous or check tests)	7	7	14
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	4	5	0
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	6	8	5
• OTF-W	8	5	3
(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)	11	9	13
(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	13
• 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 in Northamptonshire between 2018 and 2020.

Animal-level statistics (cattle)	2018	2019	2020
(a) Total number of cattle tested in the period (animal tests)	71,810	89,226	72,255
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	63	77	85
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	78	171	74
(c) Reactors detected during year per incidents disclosed during year	4.7	7.3	4.3
(d) Reactors per 1,000 animal tests	2.0	2.8	2.2
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	2	3	5
• Private slaughters	9	10	3
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	11	10	6
(g) SLH cases confirmed by culture of *M. bovis*	4	6	1

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

Note: (g) SLH cases confirmed by culture of *M. bovis*, not all cases reported are submitted for culture analysis. All cases reported are from any period prior to or during restrictions.

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

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

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	11	15	18	2	56.0%
Cattle movements	4	4	3	5	26.6%
Contiguous	2	0	0	0	0.6%
Residual infection	1	1	3	0	6.6%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	1	0	0	0	0.5%
Fomites	2	0	0	0	0.6%
Other wildlife	9	0	0	0	2.8%
Other or unknown source	3	0	0	0	6.3%

Please note that each TB incident could have up to three potential pathways so totals may not equate to the number of actual incidents that have occurred.

Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement.

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