Animal & Plant Health Agency

Year-end descriptive epidemiology report:

Bovine TB in the Edge Area of England

County: Northamptonshire

Year-end report for: 2019

Contents

Executive summary

Reporting area

Northamptonshire 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 Northamptonshire.

Local cattle industry

Northamptonshire has a 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. The dairy sector is small, accounting for approximately 10% of cattle. There is a single livestock auction market (Thrapston market) in Northamptonshire, but substantial trade of cattle occurs through Rugby market in Warwickshire and Thame market in Oxfordshire (both Edge Area counties).

New incidents of TB

The number of new incidents has been rising consistently over the last five years, reaching 34 new incidents in 2019, an increase by five on 2018. This has led to the increasing trend in the annual herd incidence rate (reaching 6.5 incidents per 100 herd-years at risk in 2019) and is the sixth lowest amongst the Edge Area counties and around 34% below the average incidence of the Edge Area (9.9).

Suspected sources and risk pathways for TB infection

The key driver of infection was infected badgers, which accounted for 52% of the weighted contribution of all potential risk pathways for herds with new TB incidents reported in 2019. This was followed by inward cattle movement (purchase) with a weighted contribution of 24% with wild deer and residual infection at 4%.

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

Enhanced surveillance testing such as radial, six-monthly post incident, check or trace testing detected 56% (19/34) of incidents in 2019. Passive slaughterhouse surveillance detected nearly 15%

(5/34) of infected herds with the remainder being disclosed by the annual surveillance whole herd testing.

Reactor numbers

In 2019, 248 reactors were removed, an increase of 107 on 2018, and the highest number in the last decade. There were 171 interferon gamma (IFN-γ) test positive animals, more than double the number disclosed in 2018 (n=78).

Risks to the reporting area

The highest risk is to the areas of Northamptonshire with the greatest herd and cattle densities which are in close proximity to the Warwickshire and Oxfordshire borders. The main flow of purchased cattle is from the markets in those counties supplying higher risk stock. A particular area in south-west Northamptonshire experiences higher herd incidence and prevalence, where wildlife is thought to be the main driver of infection.

Risks posed by the reporting area

The risk posed by Northamptonshire to the adjoining LRA counties is very low due to the geographical distance between the endemic front and those counties, in between which is a buffer area of low herd and cattle density. The risk posed by Northamptonshire to the adjoining Edge Area counties varies. The risk to Warwickshire and Oxfordshire is probably equal at the borders with those counties due to shared wildlife populations (badgers and deer). The risk posed by cattle movement to those two counties however is lower due to the flow being predominantly towards Northamptonshire. There is no evidence currently suggesting any particular risks to Leicestershire or 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 in cattle in the Edge Area. This is compromising the goal of achieving OTF status for the county. Urgent actions, with responsibility ideally shared between government and industry are required to address the disease burden within the county. Tighter control over purchased stock, such as introduction of compulsory post-movement testing may help to address the risk that movements of cattle from higher incidence areas pose to the county.

Introduction

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

Cattle industry

Herd types

Cattle density in Northamptonshire is low and unevenly distributed, with the western half of the county having the highest density. Over the last five years the cattle population has been steadily decreasing, by roughly 1000 animals a year. The average number of cattle per holding however has remained stable (varying between 100 and 102) whilst the median has been increasing consistently, from 43 in 2015 to 56 in 2019 (Appendix 2, Table A2.1). These figures suggest while the herd sizes are increasing, the number of herds is decreasing. Small holdings (fewer than 50 cattle) are predominant, accounting for 48% of herds, with those being large or very large representing only 3% (each) of the total (Figure 1).

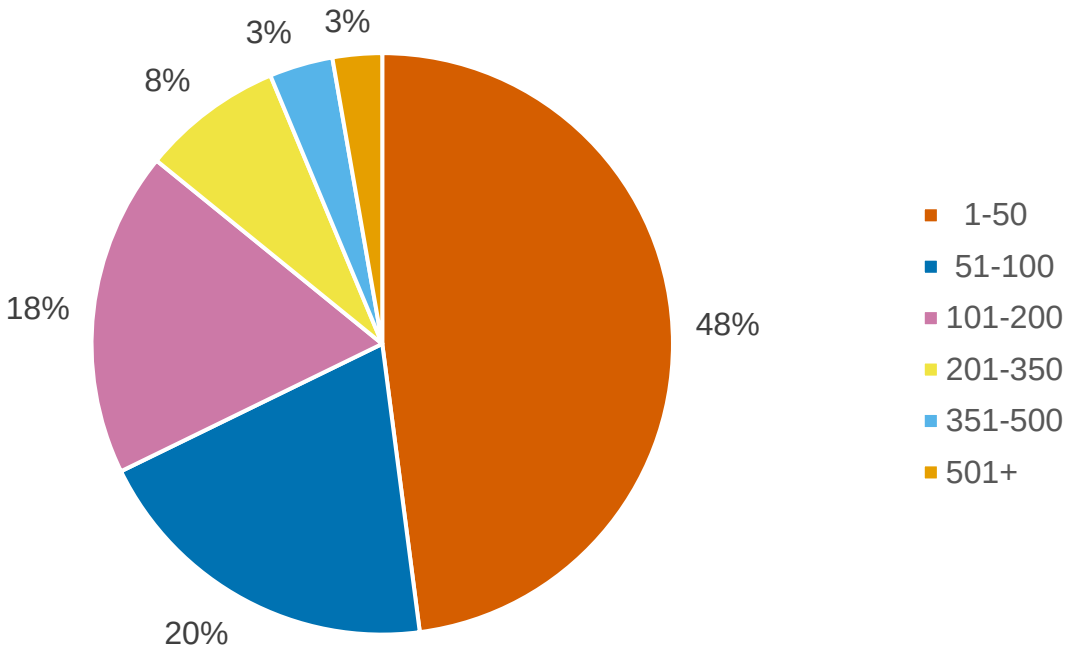

Figure 1: Proportion of cattle holdings by herd size in Northamptonshire in 2019 (n=509).

Beef herds continue to predominate. In 2019, 85% of cattle were beef-sired whilst the proportion of dairy-sired cattle has been reducing, equating to 11% of all cattle in the county (Appendix 2, Table A2.2). The majority of the beef herds are of the suckler type but a significant proportion is of the fattening type. Traditional farming practices where cattle are grazed during the summer months and housed over the winter are the most commonly observed. This has been influencing the timing of the routine TB testing as it is preferentially conducted during housing, which has been correlated in the past with timing of peaks in incident disclosure. 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 10 miles of the main premises).

Arable farming is widespread in Northamptonshire. Cattle herds are often an additional business, with the focus on the arable operations as the main source of income.

Markets

Northamptonshire has one livestock auction market (Thrapston market), which is located in the eastern part of the county where the herd and cattle density is lowest. Thus, the main flow of cattle is through Rugby market in Warwickshire and Thame market in Oxfordshire (both in the Edge Area).

Approved Finishing Units

There has been a trend of fattening farms converting to Approved Finishing Units (AFUs), where cattle are housed at all times in wildlife proof buildings and are exempt from routine surveillance testing. If operated correctly, such units provide an outlet for the fattening and/or finishing of negative tested cattle from TB-restricted holdings without increasing the TB risk in the area where they are located. In 2019 there were 13 registered AFUs in Northamptonshire, an increase by one from the previous year. Pre-movement Testing Exempt Finishing Units (EFU) provide another alternative route for beef finishing enterprises to purchase animals intended for slaughter, without the need for pre-movement testing. There is only one EFU registered in Northamptonshire in 2019, with no change from the previous year.

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.

Over the last five years, Northamptonshire has seen a growth in the number of new incidents with the greatest number recorded in 2019 (n=34), an increase of five on the previous year (Figure 2). This is also reflected in the increased herd incidence rate of 6.5 per 100 herd-years as risk which has more than doubled since 2015 (Figure 3). The risk of cattle herds becoming infected in 2019 as defined by the number of incidents over the number of unrestricted cattle herds at the beginning of 2019 is slightly higher and equated to 6.9. The specific short term objectives of the Edge Area policy were to maintain herd incidence of OTF-W incidents <2% overall by 2019. Unfortunately, this objective could not be achieved with crude OTF-W incidence reaching 3.1% in 2019.

Whilst the numbers of new incidents attributed to movements of infected cattle has remained relatively stable, the number of new incidents due to local spread in certain areas has increased. In response to the increasing risk, the frequency of surveillance testing was adjusted to annual in 2014. The higher number of tests conducted was expected to result in an increase in incidence, confirming that enhancing surveillance measures was the right approach.

Timely disclosure of infected herds allows for the more rapid deployment of disease control measures. To some extent this is reflected in the reduced disease prevalence from 4% in 2018 to 3.44% in 2019 (Figure 4). This indicates that overall duration of incidents was shorter, which is more likely to be achieved with early disease detection. This reduction in prevalence however needs to be interpreted with caution because in 2018 the majority of the incidents were detected in the last quarter of the year which subsequently, with at least four to five months usually needed for an incident to resolve, caused them to be incomplete by the end of that same year giving rise to the burden of disease reported in 2019.

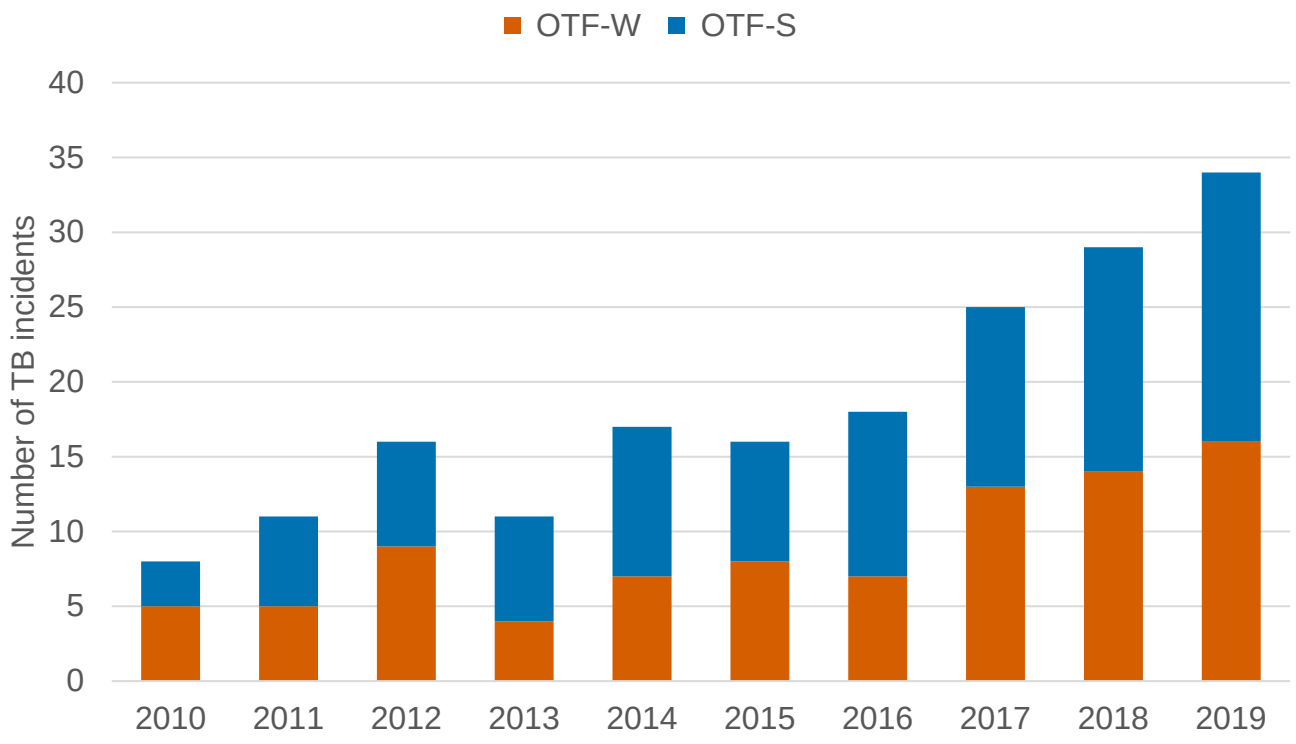

Figure 2: Annual number of new TB incidents in Northamptonshire, 2010 to 2019.

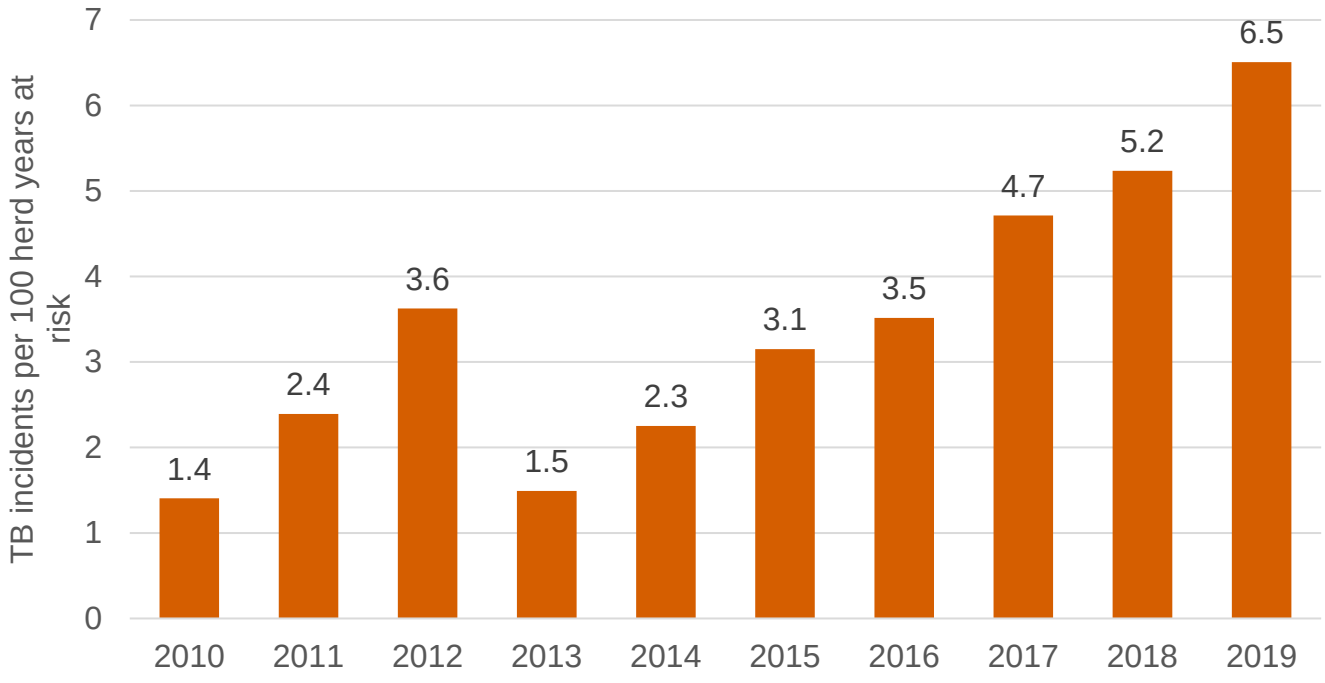

Figure 3: Annual herd incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Northamptonshire, 2010 to 2019.

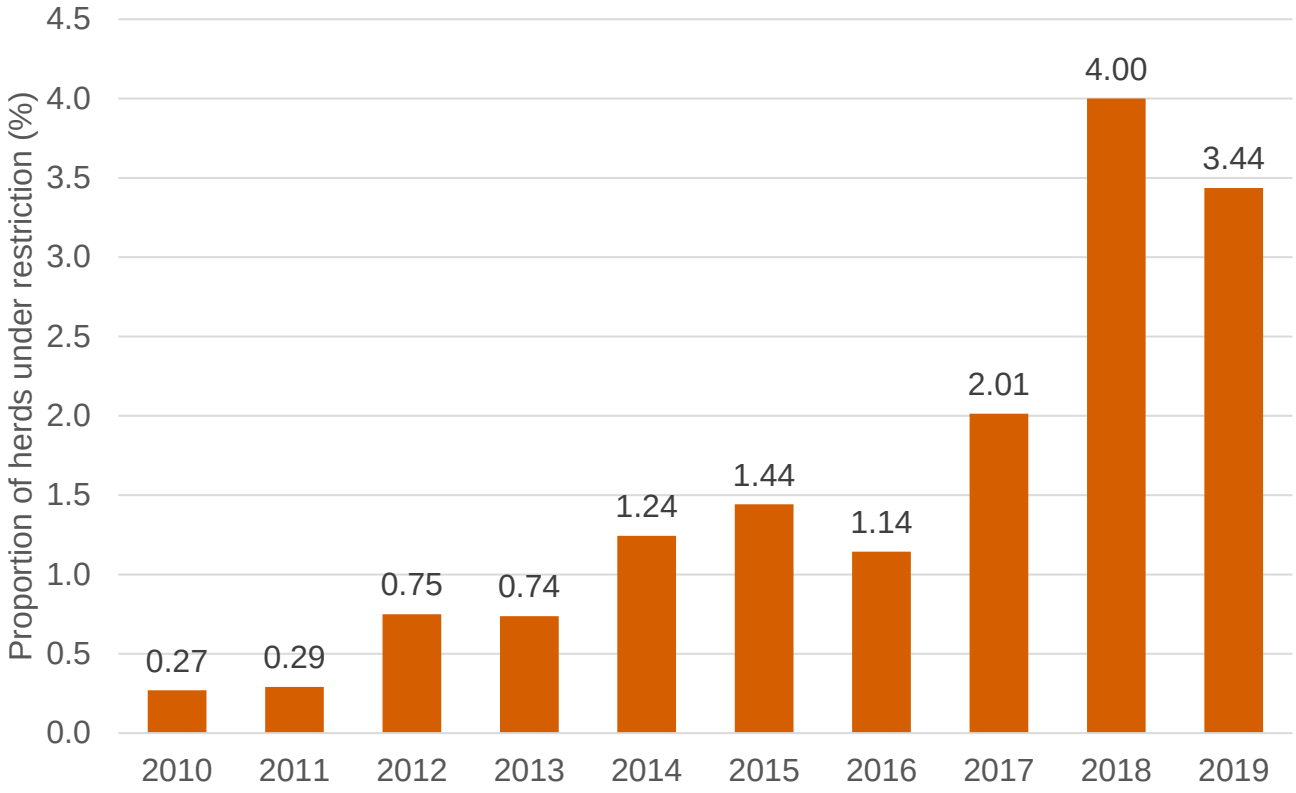

Figure 4: Annual end of year TB herd prevalence in Northamptonshire, 2010 to 2019.

Geographical distribution of TB incidents

Compared to all other Edge Area counties, Northamptonshire had the sixth lowest incidence of TB in 2019, equating to 6.5 (Figure 5), with the bordering counties of Warwickshire (17.0) and Oxfordshire (23.8) having much higher incidence. Despite the increasing disease risk in Northamptonshire the county's incidence is still around 34% lower than the overall average incidence for the Edge Area (9.9).

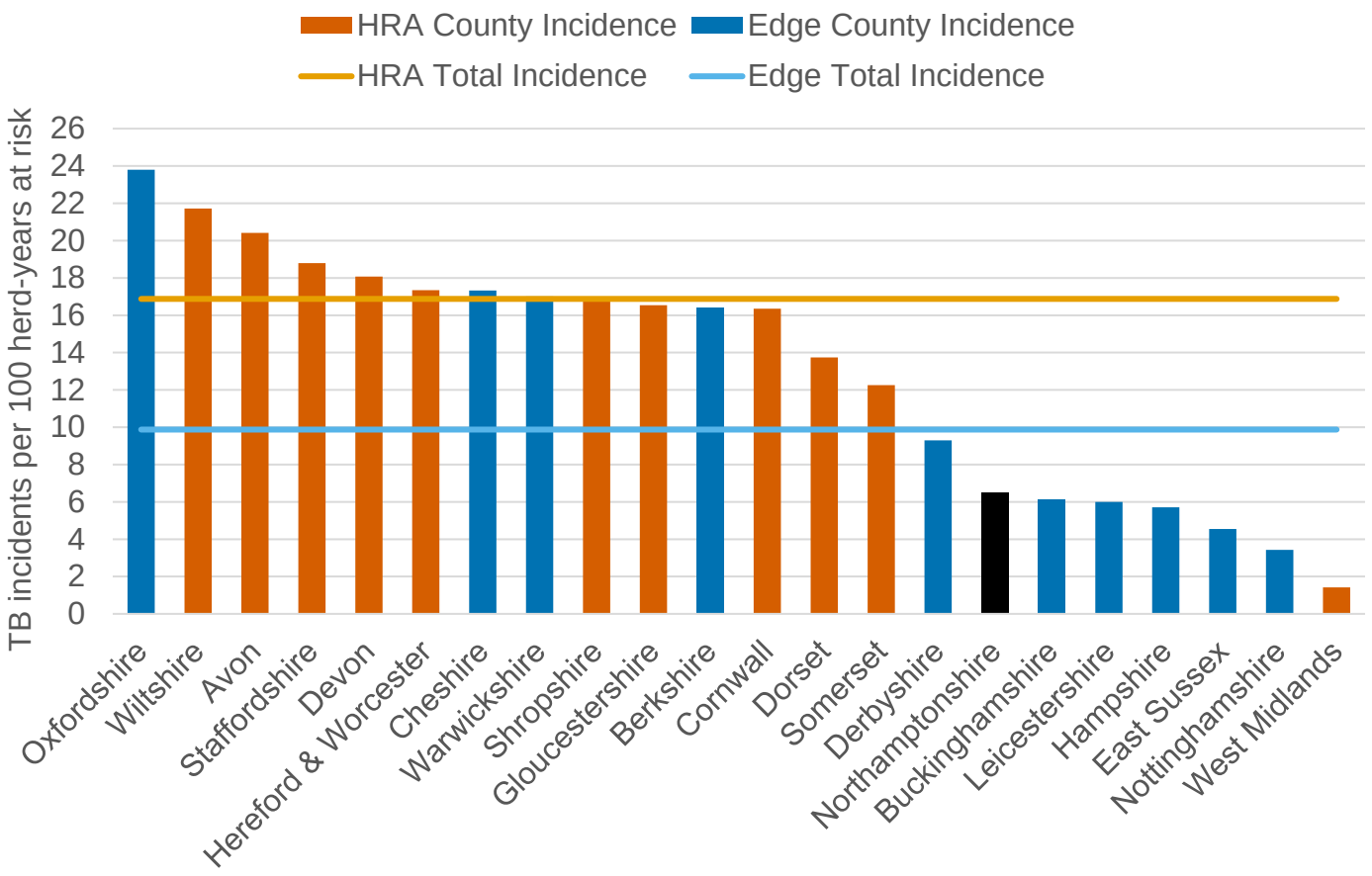

Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in 2019, by HRA and Edge Area County.

High herd and animal densities continue to be observed along the border with Leicestershire. Herd size is usually positively associated with risk of TB. Thus, the lower number of incidents detected in this area regardless of the significant number of pre-2019 OTF-W incidents on the Leicestershire side of the border may be partially due to smaller herd sizes. It is also plausible that the predominant type of cattle farming in that area differs from the worst affected areas of Northamptonshire (bordering Warwickshire and Oxfordshire).

Since 2016, an area of decreased cattle holding density has emerged in the southernmost tip of the county, and has progressively expanded over the following years. In 2019, it appears that new herds were registered along the western border with Oxfordshire around Brackley, thereby reducing the size of this area.

However, for the first time there is an area with <10 cattle/km² around Wellingborough (Figure 6). There is a clear positive correlation between levels of TB incidence, and cattle density especially when combined with proximity to higher incidence areas such as Warwickshire and Oxfordshire (both are Edge Area counties).

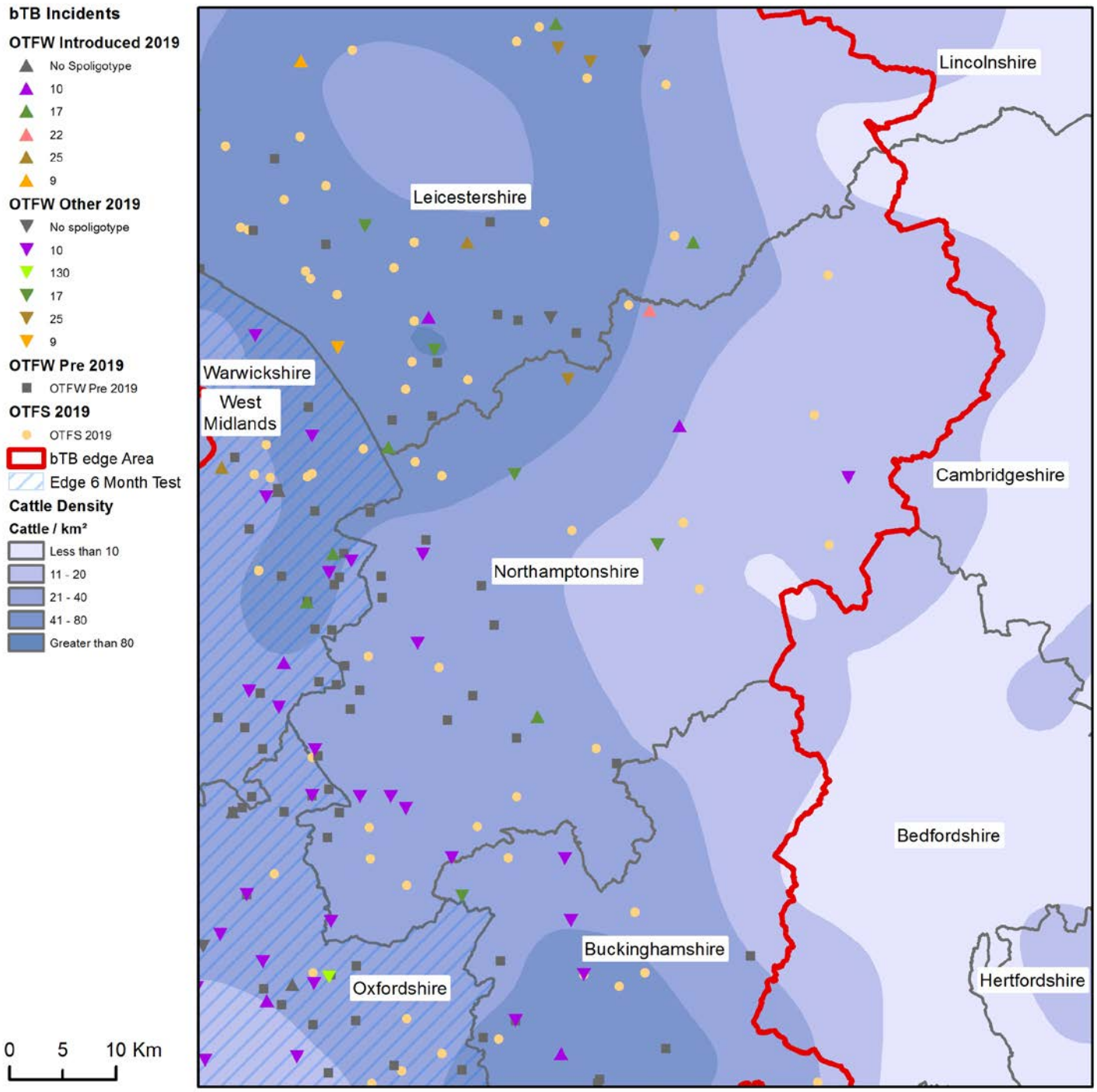

Figure 6: Location of cattle holdings in Northamptonshire with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the beginning of 2019, overlaid on a cattle density map. To note, 'OTF-W Introduced 2019' refers to OTF-W incidents in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

In 2016 a new cluster of incidents, consisting of nearly half of the OTF-W incidents for that year, formed in Daventry parish (west Northamptonshire). Epidemiological investigations and molecular typing of *M. bovis* from those herds provided evidence that this may have been a result of expansion (driven predominantly via wildlife) of endemic areas from east Warwickshire and north Oxfordshire.

The Daventry cluster of incidents has remained and expanded over the following years. The majority of cases remain consistently aligned along the county border with Warwickshire and north Oxfordshire, with eastward scatter from there along the B4525 road into Northamptonshire, mirroring to a greater extent the epidemiological picture of the last few years (Figure 6, Figure 7 and Figure 8).

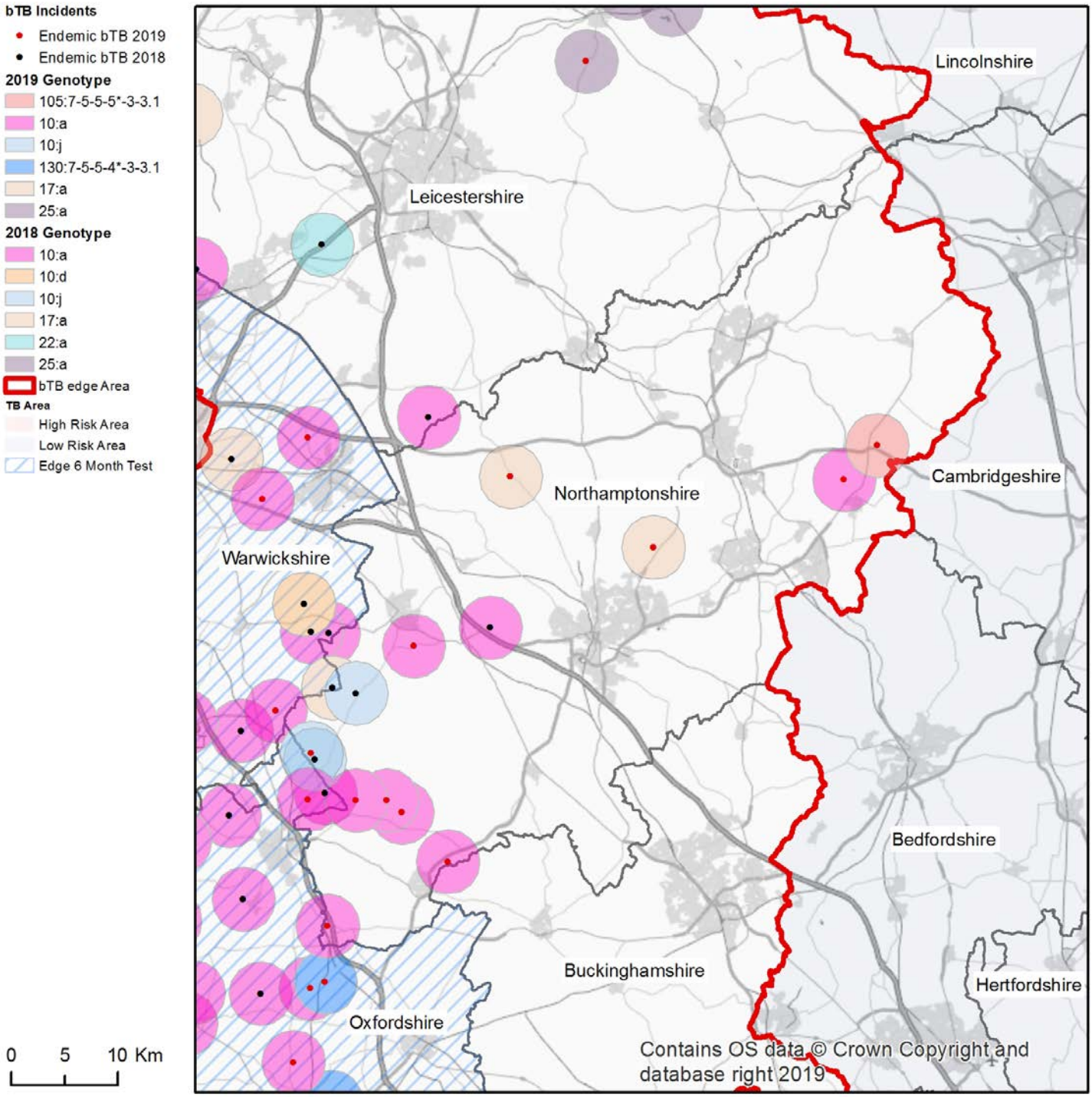

Figure 7: Genotypes of *M. bovis* detected in Northamptonshire in 2018 and 2019, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemic infection within local wildlife populations (OTF-W incidents only).

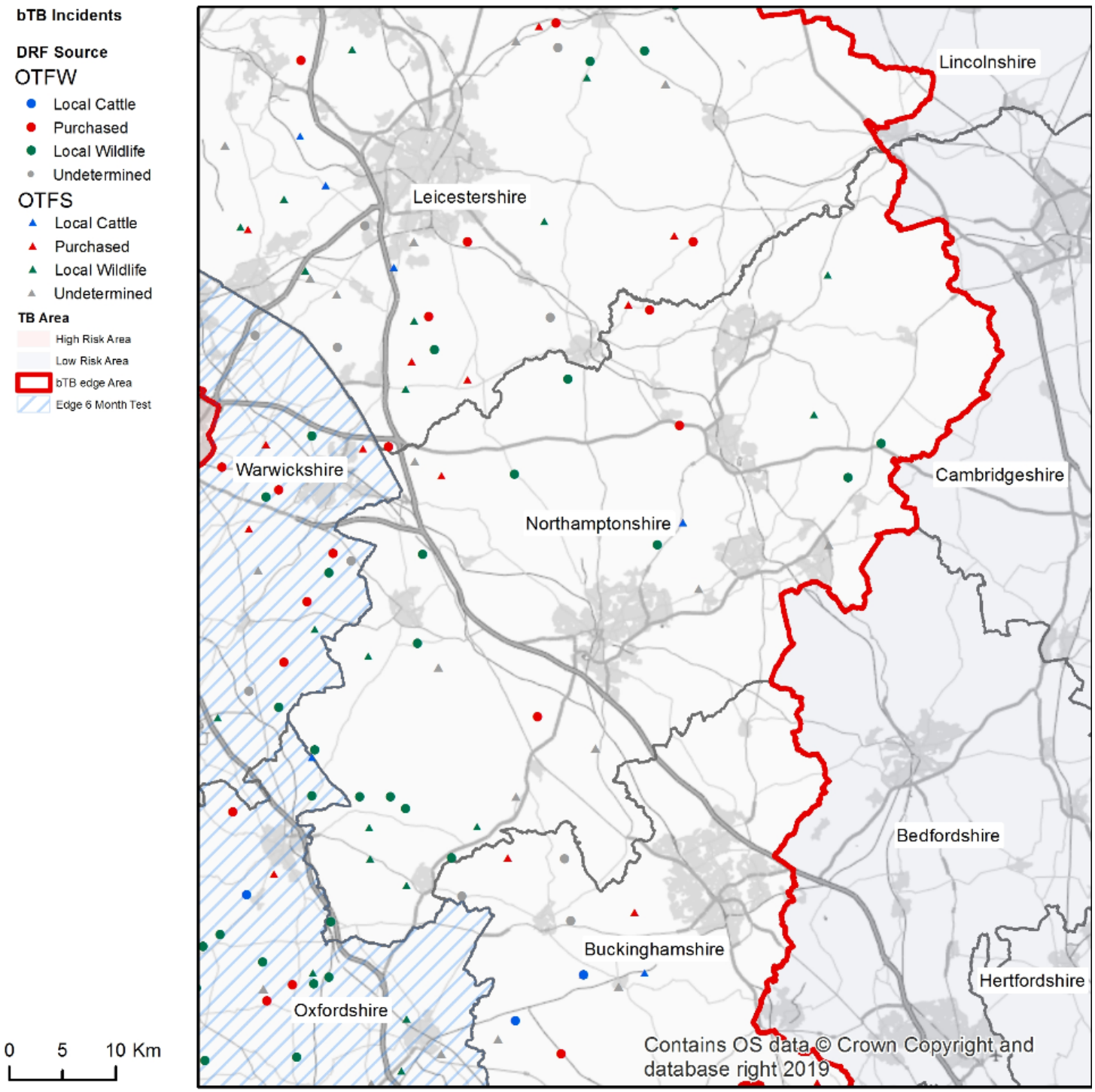

Figure 8: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Northamptonshire, and its adjoining Edge Area counties, which started in 2019.

The area bounded by the county border to the west, the M1 to the north-east, the B4525 to the south, and the A43 to the south-east, is densely populated by arable and cattle farming. 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 in this

area with plenty of suitable habitat and with physical boundaries to stop its movement. Of the 11 OTF-W incidents in 2019 considered to be due to endemic infection in the wildlife, 63% (n=7) were in west Northamptonshire. Six of the incidents had *M. bovis* genotype 10:a. One incident was associated with genotype 10:j (previously reported as 10:7-5-6-4*-3-3.1 and closely related to 10:a), and was located in an area of west Northamptonshire, where genotype 10:j was previously identified in 2017 and 2018. The possibility of spread via local infected cattle has been carefully assessed and ruled out, leaving wildlife (mainly badgers) as the main vector.

The predominant genotype found in Northamptonshire (10:a) is also predominant in the two neighbouring Edge Area counties. Infection expansion observed from those areas over the last five years, whilst believed to have been driven by wildlife, may also have been facilitated by cattle movements. The fattening stock are frequently supplied by dealers and sourced from various high TB risk area livestock markets. So far there is no evidence for these incidents causing long-term impact on TB in the county, possibly due to a combination of surveillance testing and short duration of stay on Northamptonshire holdings.

Generally, only a small proportion of incidents in 2019 were attributed to purchases of cattle with undisclosed infection. Of those incidents, where the highest degree of confidence in the assessment of the risk pathway could be provided (Figure 8), nearly 15% (n=6) were as a result of purchased infection compared to 58% (n=20) resulting from wildlife exposure. These figures differ from the weighted source of infection where additional possible sources of infection and uncertainty levels have been taken into consideration. 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).The introduction of infected cattle was the main risk identified among fattening herds due to the amount of cattle traded in this type of business. Purchased source of infection was also identified in dairy and suckler herds and had no association with specific areas, highlighting the importance of this risk.

Other characteristics of TB incidents

Incidents by herd types

Similar to previous years, the majority of incidents (both OTF-S and OTF-W) occurred in beef suckler herds. This is consistent with this herd type being the predominant enterprise in the county (Figure 9).The positive correlation between herd size and the likelihood of experiencing a TB incident is applicable in Northamptonshire. Herds with 50-100 cattle were almost three times more likely (7%, 11/92) to experience a TB incident compared with those having fewer than 50 animals with only 2.5% (6/244) of them being affected. Consistent with this trend, 12% (11/92) of the herds with 101-200 animals suffered an incident, of those with 201-350 cattle 12.5% (5/40) were affected by TB, whereas a much greater proportion, 36% (5/14), of the largest cattle herds had an incident. The number of incidents in dairy herds has doubled since 2018 (n=4). It is of note that two of the four incidents occurred in two herds which experienced an incident in 2018 (one of them now OTF-W). The remaining two dairy herd incidents in 2019, both being OTF-S, occurred in the same herd during the course of the year. The first incident occurred early in the year, resolved uneventfully following the

required testing and subsequently reoccurred at six-monthly post-incident test, most likely due to residual infection.

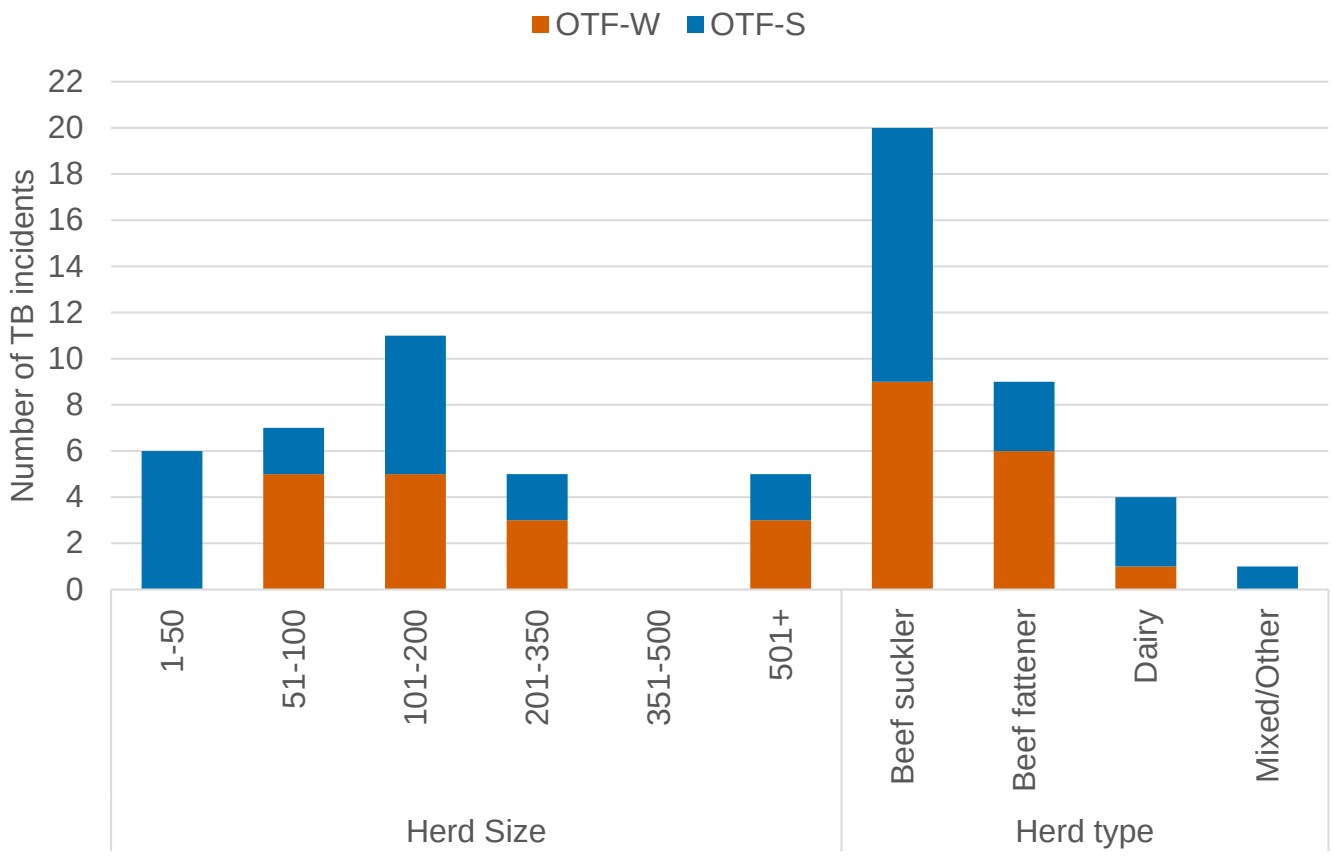

Figure 9: Number of new TB incidents (OTF-W and OTF-S) in Northamptonshire in 2019, by cattle herd size and type.

Incidents by month of disclosure

A peak of incidents has been observed in the past during the latter part of the year, coinciding with the winter housing period. In 2018, however this slightly changed with 55% (n=16) of the incidents disclosed in the last quarter of the year which was reflected in the sharp increase in herd prevalence for that reporting year. In 2019 there were two peaks of incidents disclosed (Figure 10), which differs to 2018. The first one was in early summer partially due to radial testing disclosing the majority of OTF-S incidents for that period. The second peak was in the autumn, largely due to second round of radial testing disclosing 44% (n=8) of those incidents. These findings highlight the value of enhanced surveillance testing around OTF-W incidents in detecting lateral spread of infection.

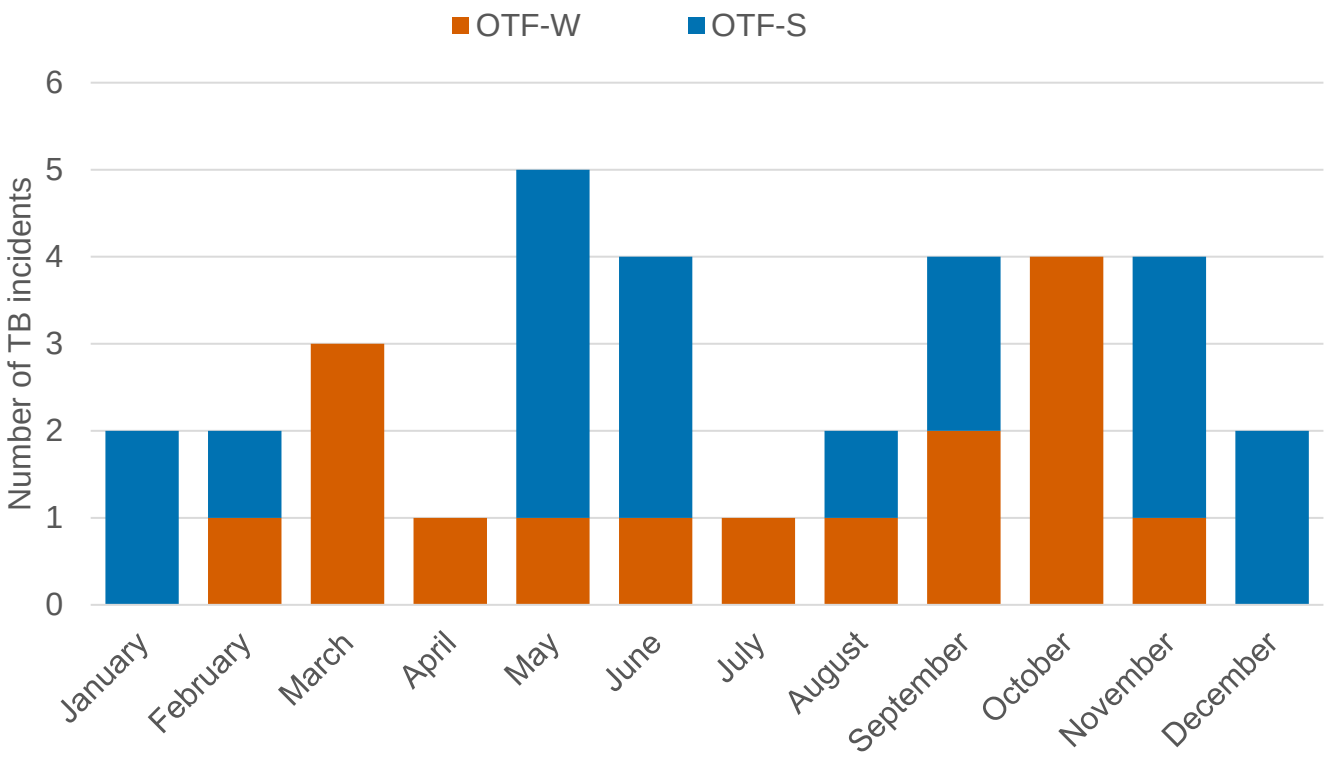

Figure 10: Number of new TB incidents (OTF-W and OTF-S) in Northamptonshire in 2019, by month of disclosure.

Genotypes of *M. bovis* isolated

The four different genotypes of *M. bovis* detected in Northamptonshire in 2018 (10:a. 10:j, 17:a, and 25:a) were again detected in 2019. Two additional genotypes, 22:a and the rare 105:7-5-5-5*-3-3.1 were also isolated from incidents in 2019 (Figure 11). The most commonly detected genotype was 10:a, associated with 57% (n=9) of the OTF-W incidents (Figure 7). The second most frequently identified genotype was 17:a, associated with 19% (n=3) of the OTF-W incidents. This genotype has a large homerange crossing the majority of the HRA. In Northamptonshire, genotype 17:a has usually been associated with cattle movements. In 2019, two of the three incidents with this genotype were attributed to infected badgers. The remainder of the genotypes identified in 2019 were only detected once. The rare genotype (105:7-5-5-5*-3-3.1) is thought to be caused by a random mutational event of spoligotype 17. It is however not possible for this to be confirmed with the present data.

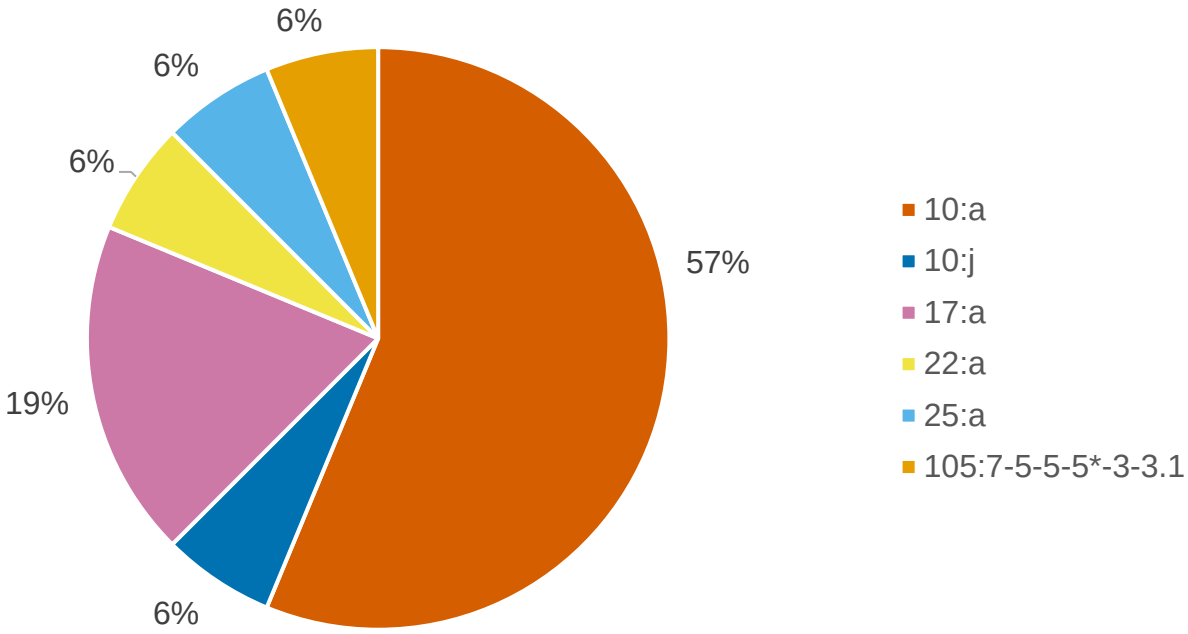

Figure 11: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Northamptonshire in 2019 (n=16).

Duration of incidents

The usual length of an incident in Northamptonshire is between 151 and 240 days, which accounts for incident herds undergoing at least two short interval tests a minimum of 60 days apart and time elapsing for removal of reactors. In 2019, two thirds of the incidents fell into that category (n=26; Figure 12) indicating that incident resolution was achieved without any significant complications. As expected OTF-W incidents have a tendency to last longer than OTF-S incidents, with a median duration of 194 and 172 days respectively in 2019. There were no persistent incidents (those with duration exceeding 551 days) for the reporting period. The number of incidents lasting longer than the median has more than doubled (n=8) compared to the previous year. Most of these were OTF-W incidents (n=7), where all but one began in 2018. The longer lasting incidents were in suckler herds except one in a fattening herd.

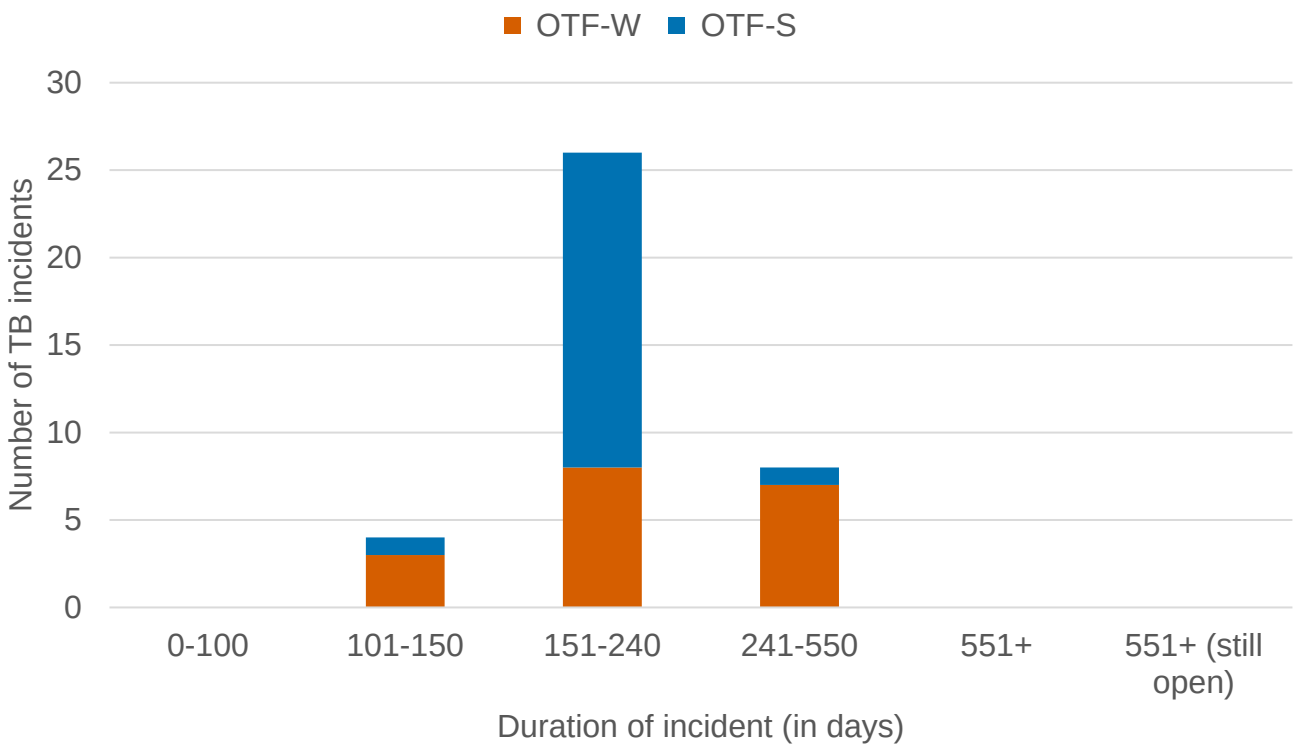

Figure 12: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Northamptonshire. Note that Approved Finishing Units (AFUs) have been excluded.

Suspected sources, risk pathways and key drivers for TB infection

It can be challenging to retrospectively establish the route of infection for a TB incident herd. The Animal and Plant Health Agency (APHA) aims to complete an epidemiological assessment for all TB incidents in the Edge Area (both OTF-W and OTF-S). This includes a thorough on-farm investigation and scrutiny of routinely collected data; such as cattle movement records, and the results of molecular analyses where available.

During the assessment up to three risk pathways of infection are selected for each herd. Each risk pathway is given a score that reflects the likelihood of that pathway bringing TB into the herd. The score assigned has been updated this year to reflect developing understanding of how likelihood is being assessed in practice. It is recorded as either definite (score 8), most likely (score 6), likely (score 4) or possible (score 1). The source(s) for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely or possible sources can contribute towards the overall picture for possible routes of introduction in to a herd. If the overall score for a herd is less than six, then the score is made up to six using the ‘Other/Unknown Source’ option. Buffering up to six in this way helps to reflect the uncertainty in assessments where only ‘likely’ or ‘possible’ sources are identified.

The weight of infection outputs in Appendix 4 are produced by combining the data from multiple herds and providing the proportion of pathways in which each source was identified, weighted by certainty that each source caused the introduction of TB. The outputs do not show the proportion of herds where each pathway was identified (this is skewed by the certainty calculation). Genotyping of *M. bovis* isolates can be a powerful tool in identifying a likely source of infection, however genotypes are not determined for OTF-S herds. The inclusion of OTF-S herds in these calculations increase the uncertainty in the outputs. As a result, the relative proportions of each risk pathway is very approximate and only broad generalisations should be made from these data. A more detailed description of this methodology is provided in the Explanatory Supplement for 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

Key drivers of infection

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

- Infected wildlife
- Cattle purchases from high incidence areas

Sources of infection and risk pathways

Infected badgers contributed to 68% of weighted source pathway attributions of new OTF-W incidents (Figure 13a) and 38% of new OTF-S incidents (Figure 13b) in Northamptonshire in 2019,, which is a reduction from 2018 (63% for all TB incidents compared to 52% in 2019) . The reduction is partially a result of changes to the algorithm used to calculate the weighting of the different risk pathways for the reporting period. The current figure provides better reflection of the real-life representation of the various risks, acknowledging the fact that in many incidents more than one risk pathway is likely.

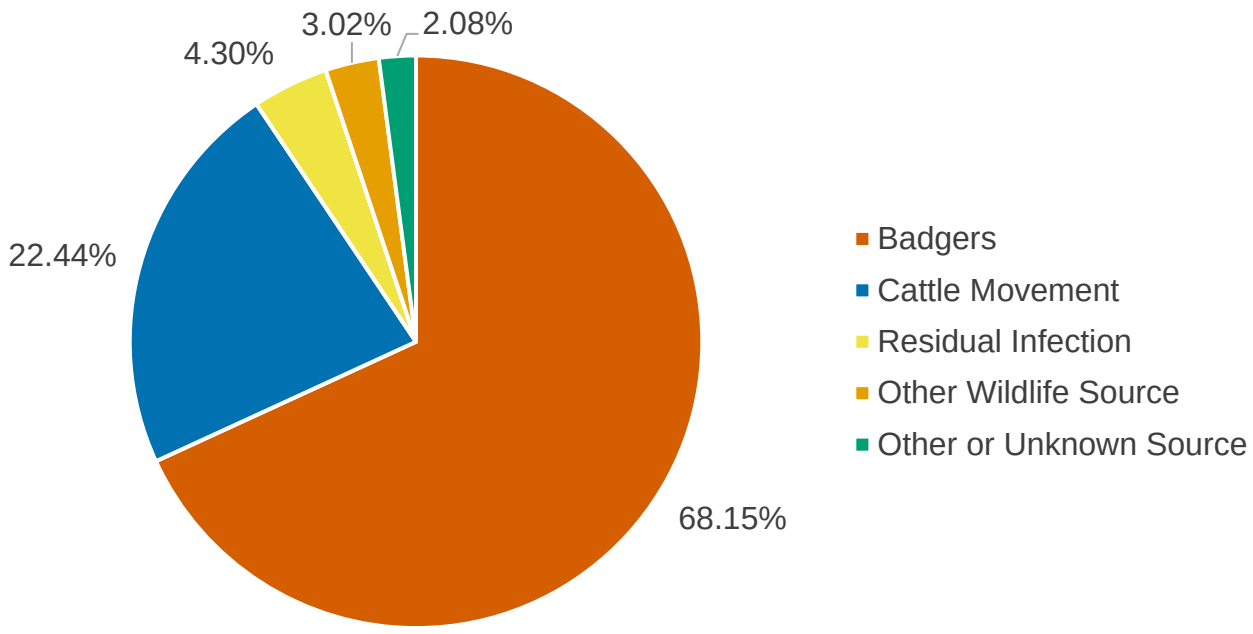

Figure 13a: Summary of the weighted source of infection pathways attributed for all OTF-W incidents in Northamptonshire that started in 2019, that had a completed DRF (16).

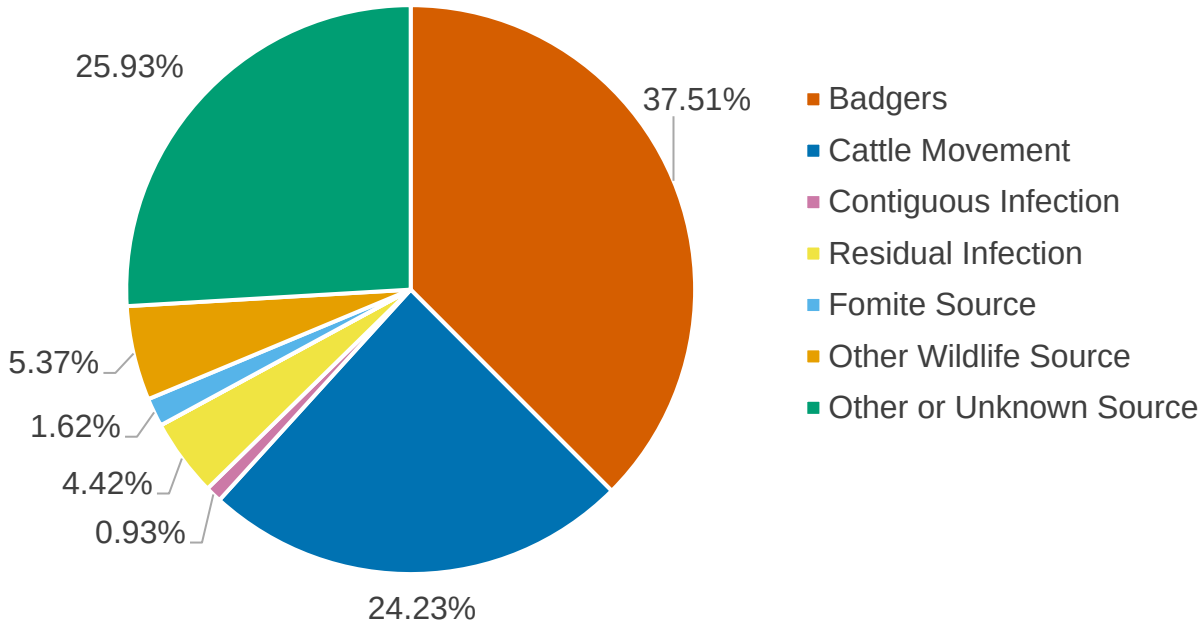

Figure 13b: Summary of the weighted source of infection pathways attributed for all OTF-S incidents in Northamptonshire that started in 2019, that had a completed DRF (18).

Infected badgers were implicated for the first time in a number of incidents in areas of the county with previously very low infection rates (n=7; and then usually attributed to purchased stock). Infected wildlife (which in a limited number of incidents would have had wild deer considered as possible risk in addition to badgers) was the most likely source of infection in both fattening and suckler beef herds, while in the dairy sector only two incidents were attributed to that risk pathway (Figure 14).

Purchased cattle contributed to 23.4% of weighted source pathway attributions for all TB incidents in 2019 (Appendix 4) which is a reduction from the 32.3% in 2018. Purchasing practices are at the core of this significant driver of disease spread and is a risk applicable to any size and type of herd (Figure 14).

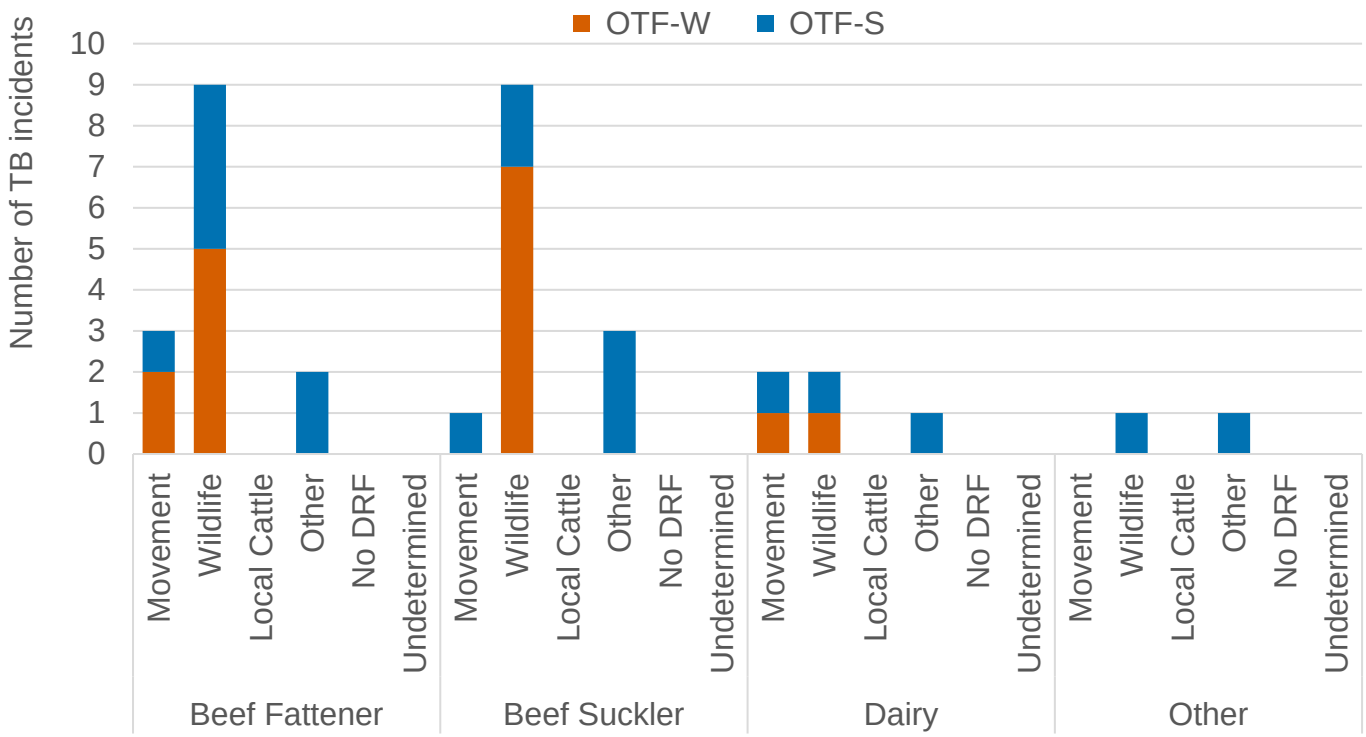

Figure 14: Source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in Northamptonshire in 2019, by herd type. Note that the categories ‘movement’, ‘wildlife’, and ‘local cattle’ are comprised of incidents where these were the most likely single source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

Currently there are no enhanced measures applied in addition to the key control measures in Northamptonshire (Appendix 1). Radial testing as an enhanced surveillance measure appears to provide better disease control in areas with suspected endemicity via timely detection and removal of infected cattle. While this approach would be expected to reduce the disease transmission from cattle to badgers, it will have little to no effect on the opposite direction of disease transmission.

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.

Detection of *M. bovis* in wild animals is entirely reliant on the reporting of TB-like lesions found in culled deer or wild boar. There was a single private submission of a badger carcase and no laboratory confirmed isolations of *M. bovis* in any wild or non-bovine animals in 2019.

No badger vaccination has been undertaken in Northamptonshire.

Detection of incidents

Historically the majority of incidents in Northamptonshire were detected by routine annual surveillance testing (Whole Herd Test, WHT). In 2018, enhanced surveillance testing was responsible for the disclosure of the majority of the incidents. This trend continued into 2019 where 56% (19/34) of the new incidents were disclosed during such enhanced surveillance (Figure 15), at six month post-incident testing (6M), Radial testing (RAD), immediate herd check test instigated when a source herd is traced (CT), forward trace test (TR). This provides evidence of the efficacy of enhanced control measures applied using a risk based approach, allowing timely detection of residual, recently introduced or re-introduced infection. More incidents were detected by passive surveillance applied at time of slaughter (slaughterhouse cases, SLH) in 2019 (five) compared to 2018 (three). Slaughterhouse cases in AFUs have been excluded from incidence reporting in this report (one in 2019). Three of the five slaughterhouse cases occurred in fattening herds and the remaining two in suckler herds.

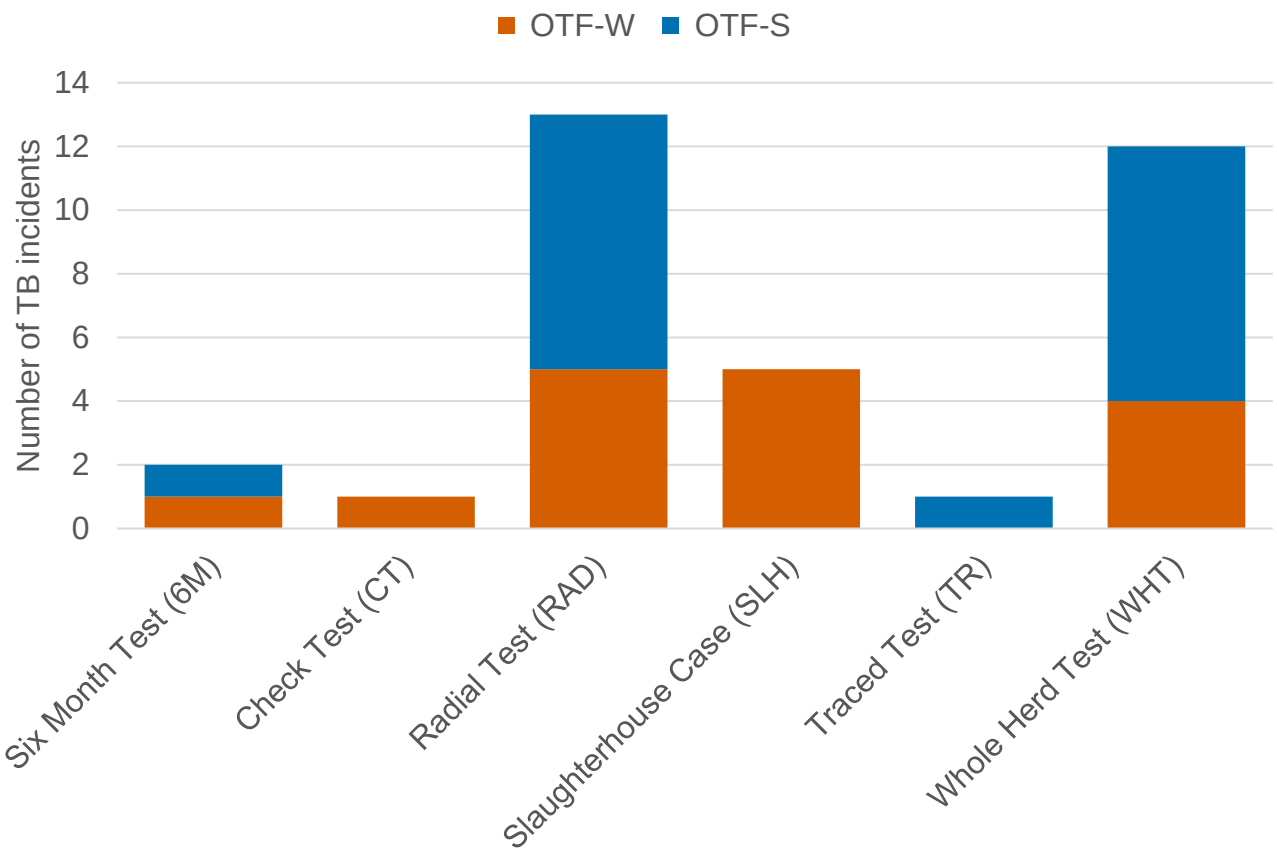

Figure 15: Number of TB incidents (OTF-W and OTF-S) in Northamptonshire in 2019, disclosed by different surveillance methods.

Consistent with previous years, the majority of the incidents in 2019 occurred in herds with no TB history in the preceding three year period (24/34; Figure 16). The number of OTF-W incidents in herds with previous history of TB incidents has increased since 2018 (from one to four), with the risk pathway identified as most likely new introduction from infected wildlife or residual infection. Four OTF-S herds also had previous TB history. In those, only one was considered to be the result of residual infection. The remaining three were most likely attributed to new disease introduction, both from wildlife and cattle movement source.

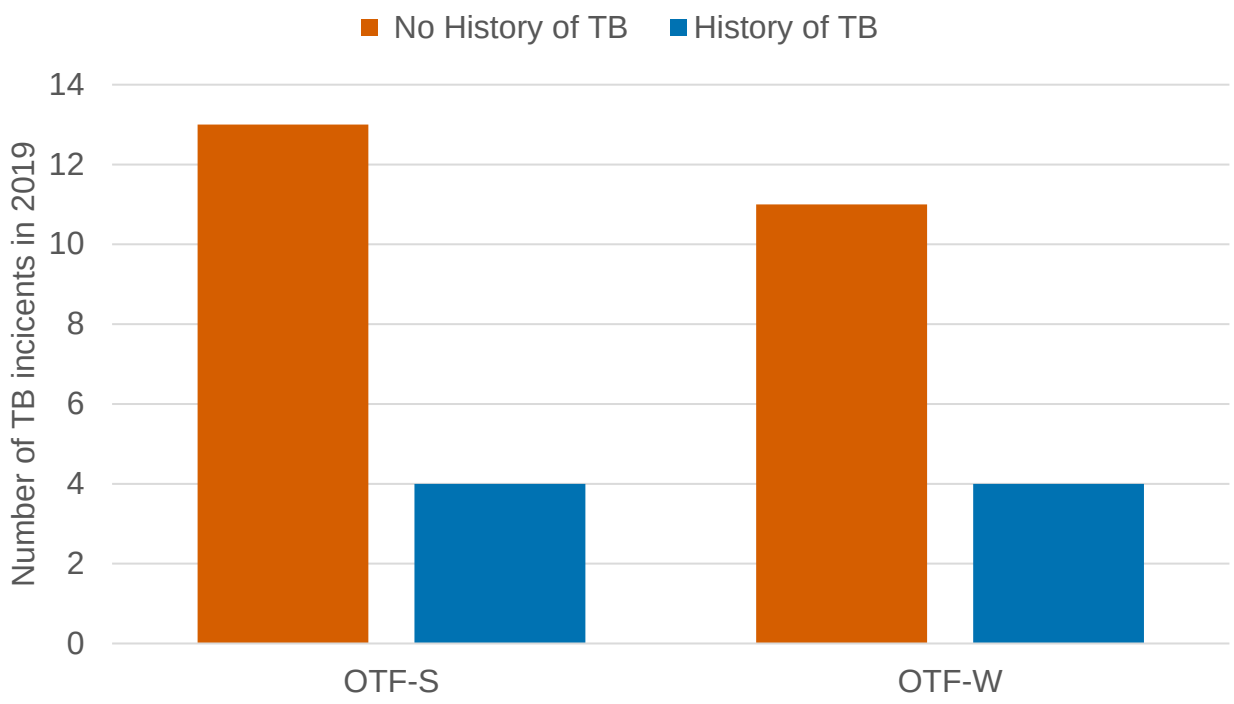

Figure 16: Number of TB incidents (OTF-W and OTF-S) in Northamptonshire in 2019 on holdings that have suffered an OTF-W incident in the previous three years, and holdings with no history of TB in the previous three years.

Skin test reactors removed and interferon gamma test positive animals removed

The total number of reactors (n=248) removed in 2019 was the highest recorded for Northamptonshire in recent years (Figure 17). In 2019, there were 107 more cattle identified and removed as reactors in comparison to the previous year. This is also reflected by the number of reactors per incident almost doubling (from 4.0 to 7.3) and reactors per 1000 animal tests (from 1.5 to 2.8) since 2017 (Appendix 3, Table A3.2). This increase has been driven by the significantly increased number of IFN-γ test positive animals, which have more than doubled since the last reporting period (an increase from 78 to 171). Four farms, in which particularly high numbers of IFN-γ test positive animals were detected, accounted for 68% of these (117/171). Approximately a quarter of the IFN-γ test positive animals were from incidents which started in 2018 (38/171). The remaining 9% (16/171) of IFN-γ test positive animals were distributed among nine of the 16 OTF-W incidents (one herd undertook natural depopulation, and therefore had no incident testing). This varied between zero to five IFN-γ test positive animals per incident. Generally, a large number of skin test reactors was followed by greater number of IFN-γ test positives, demonstrating the effectiveness of this test in assisting in disease clearance from the herd. The number of skin test reactors has remained relatively stable over the last three years despite the increasing number of new incidents.

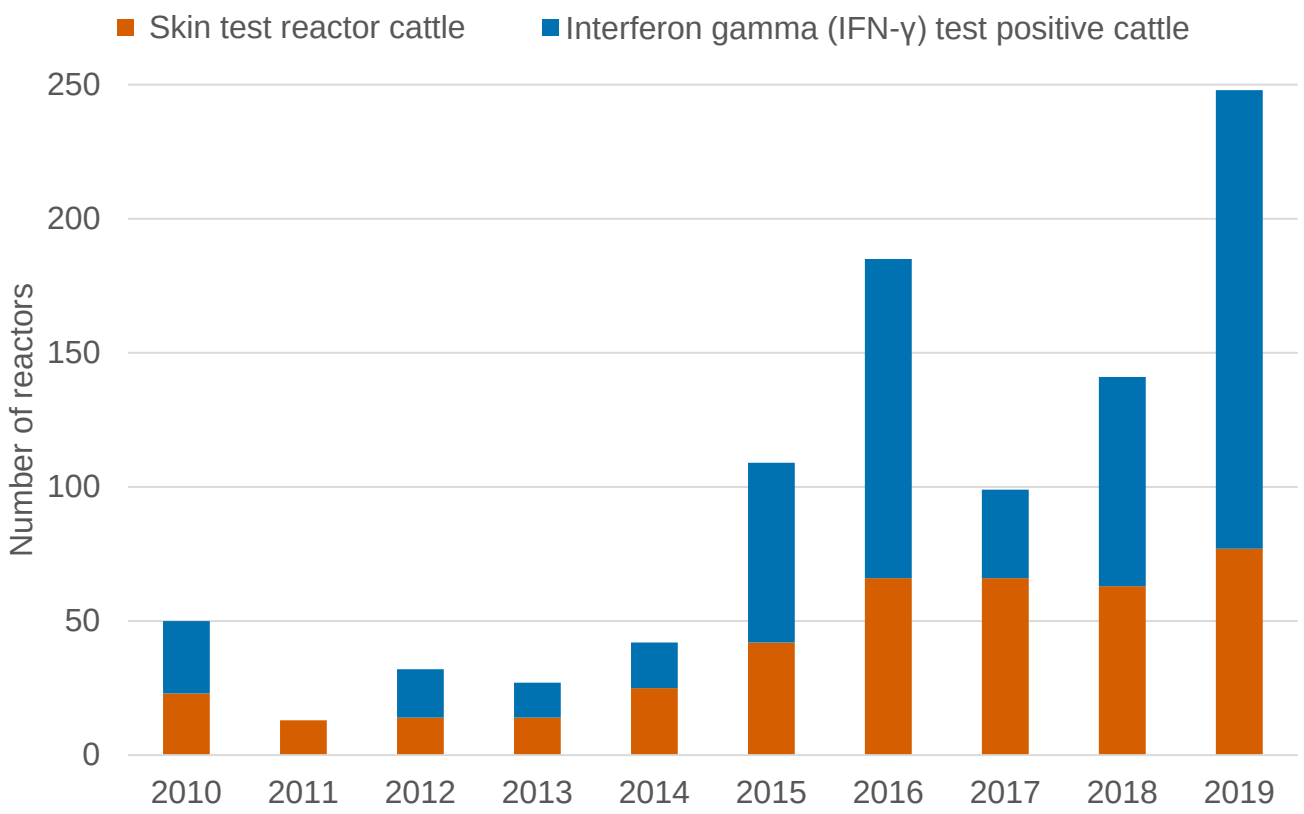

Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Northamptonshire, 2010 to 2019.

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 with significantly higher herd incidence and prevalence of infection. The geographical distribution of the incidents in Northamptonshire (Figure 6, Figure 7 and Figure 8) 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 extending farm boundaries over very large areas and into those considered endemic areas is common. 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. The risk of moving cattle with undetected infection into the county from these areas is always present and might have facilitated disease spread into local wildlife in the past. Northamptonshire also 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 genotypes associated with the HRA found in purchased animals previously. To date, there is no evidence that the movement of cattle has resulted in lateral spread within the county suggesting that disease control measures are sufficient in that respect.

Summary of risks from Northamptonshire to surrounding areas

The TB risk to the adjacent LRA counties (Cambridgeshire and Bedfordshire) is currently low due to the endemic front in Northamptonshire being geographically distant to those counties, with large areas of low cattle density between Northamptonshire and the LRA counties (Figure 6). In 2019, two separate incidents, most likely attributed to contact with infected wildlife, were detected near the Cambridgeshire border (Figure 7 and Figure 8). Radial testing of cattle herds instigated around the two incidents mentioned did not extend to Cambridgeshire where routine surveillance testing occurs every four years with no statutory requirement to pre-movement test. 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 to these two LRA counties. Both Cambridgeshire and Bedfordshire have had very few incidents over the last three years with all of those being geographically distant from Northamptonshire. However the risk to these two LRA counties may change depending on the epidemiological picture in Northamptonshire.

The TB risk to the neighbouring Warwickshire and Oxfordshire Edge Area counties is probably equal at the borders with best equal to the risk presented by them to Northamptonshire. This is due to potential shared wildlife populations (badgers and deer) in the border parishes. The risk posed by cattle movement to these two counties is however lower due to the flow being predominantly towards Northamptonshire which has lower disease prevalence. This is due to potential shared wildlife populations (badgers and deer) in the border parishes. There is no evidence currently suggesting any particular risks to Leicestershire or Buckinghamshire associated with disease being moved in either direction via cattle or wildlife.

Assessment of effectiveness of controls and forward look

The number of new incidents and the herd incidence rate in Northamptonshire have been steadily increasing since 2013 (Figure 2 and Figure 3) 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 2019 was 3.3% which does not meet the short term objective of <2%.

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. On the other hand, the improved disease control measures have performed well in terms of detecting infection earlier and removing it from the herd (only two residual infections in 2019, Figure 13 and Figure 14) but they tackled the TB problem in the cattle population only.

Appendices

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

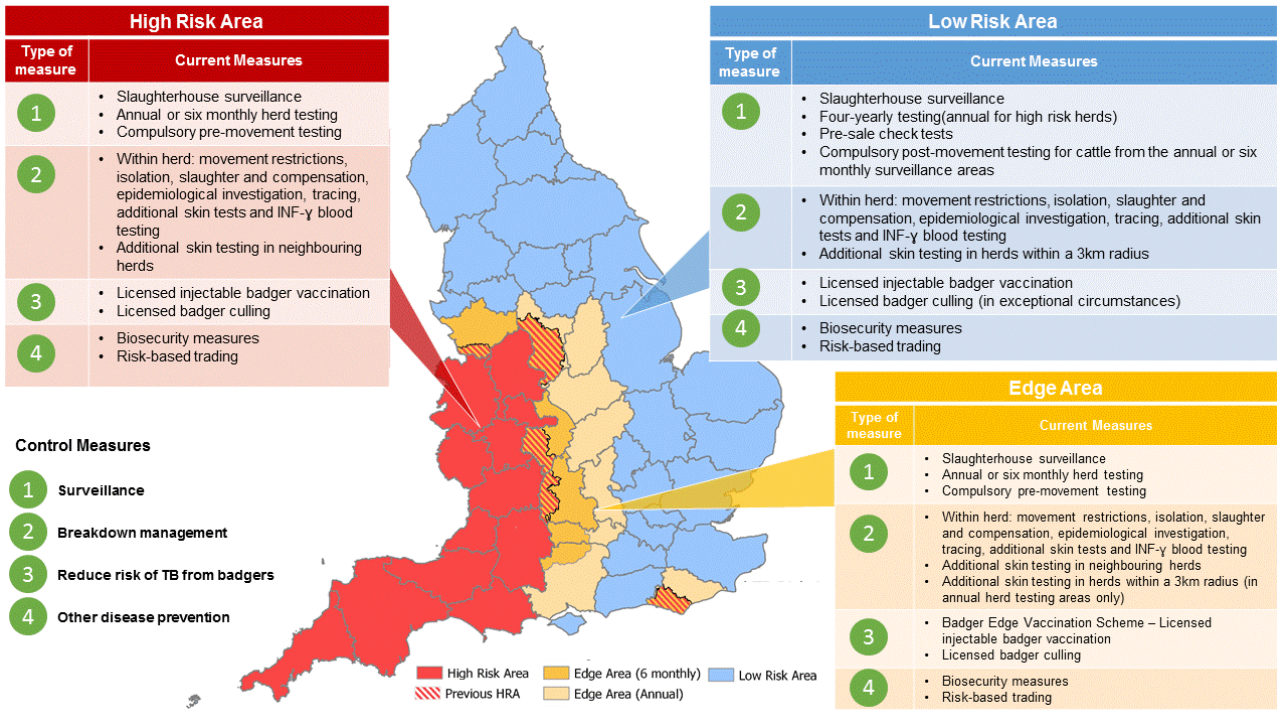

Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Bovine Tuberculosis Free status for England. Map based on information published on www.tbhub.co.uk.

Policy objectives for the Edge Area

Short to medium term:

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

Longer term:

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

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

https://www.gov.uk/government/publications/a-strategy-for-achieving-officially-bovine-tuberculosis-free-status-for-england

https://www.gov.uk/government/news/government-sets-out-next-phase-of-strategy-to-combat-bovine-tuberculosis

Key control measures

Surveillance:

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

Management of cases ('incidents'):

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

TB controls in the wildlife reservoir (badgers):

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

Other measures:

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

Summary of enhanced TB control measures in Northamptonshire

No control measures in addition to those listed above have been applied in Northamptonshire in 2019.

Active case management by APHA has allowed for nearly 1000 cattle across five different holdings to be exempted from compulsory IFN-γ testing due to being considered low risk. Two of these five holdings had complete herd exemptions while the remaining three had partial herd exemptions.

Incidents can have a significant financial impact on the farmers due to loss of production and cost of lost stock replacement. In addition, on some holdings there were challenges with obtaining grazing land away from the holding and facilitating risk assessed movement of the stock without compromising animal welfare. This in turn required 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 2019. 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 control measure, detecting 38% (13/34) of the new incidents in Northamptonshire in 2019. The majority of those radial tests (10/13) 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.

There were no persistent incidents (lasting over 551 days) at the end of the reporting period.

Other control measures:

- Occasional incidents of overdue TB testing occurred in Northamptonshire in 2019, but all of those were resolved within 60 days of the test becoming overdue, before they reached enforcement stage. Therefore no particular involvement from the Local Authority was required in 2019 in terms of TB control
- 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
- A project funded by the EU through the Rural Development Programme for England, called the TB Advisory Service (TBAS, www.tbas.org.uk/), 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. 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 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	3	244	101	92	40	18	14	512	101	56

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of Cattle	44,355 (85%)	5972 (11%)	1615 (3%)	2 (<0.01%)	51,944

Appendix 3: summary of headline cattle TB statistics

Table A3.1: Herd-level summary statistics for TB in cattle in Northamptonshire 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	608	587	595
(b) Total number of whole herd skin tests carried out at any time in the period	545	623	721
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	486	498	477
(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)	577	540	552
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	594	561	572
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	25	29	34
• OTF-S	12	15	18
• OTF-W	13	14	16
(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?	6	6	3
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	5	4	4

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.)	2	7	7
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	6	4	5
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	0	5	8
• OTF-W	0	4	5
(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)	7	11	9
(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	12	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 between 2017 and 2019.

Animal-level statistics (cattle)	2017	2018	2019
(a) Total number of cattle tested in the period (animal tests)	67,390	71,810	89,226
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	66	63	77
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	33	78	171
(c) Reactors detected during year per incidents disclosed during year *	4.0	4.9	7.3
(d) Reactors per 1000 animal tests	1.5	2.0	2.8
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	2	2	3
• Private slaughters	2	9	10
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	14	11	10
(g) SLH cases confirmed by culture of *M. bovis* **	6	4	6

* Note: reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count here

** Note: not all cases reported are submitted for culture analysis. All cases reported are from any period prior to or during restrictions

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

Table A4.1: Suspected sources of *M. bovis* infection for all of the new OTF-W and OTF-S incidents identified in 2019.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	5	7	17	2	51.9%
Cattle movements	13	3	4	1	23.4%
Contiguous	1	0		0	0.5%
Residual infection	5	1	1	0	4.4%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	2	0	0	0	0.9%
Other wildlife	11	0	0	0	4.3%
Other or unknown source	4	0	0	0	14.7%

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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