Animal & Plant Health Agency

Year-end descriptive epidemiology report:

Bovine TB in the Edge Area of England

County: Warwickshire

Year-end report for: 2019

Contents

Executive summary

Reporting area

Warwickshire 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 Warwickshire.

Local cattle industry

Small (up to 50 cattle) beef units are predominant in the county.

New incidents of TB

The number of new incidents in Warwickshire has been rising slowly over the last ten years, reaching a peak of 83 incidents in 2017. A slight decrease has been noted since then; 80 incidents in 2018 and 68 in 2019. This is despite an increased surveillance testing frequency and the incorporation of the former High Risk Area (HRA) portion of the county into the Edge Area.

Suspected sources and risk pathways for TB infection

Contact between cattle and badgers, cattle movements and exposure to other wildlife species were the most common source of infection for TB incidents in Warwickshire in 2019 (in order of descending importance).

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

The majority of new TB incidents in 2019 were disclosed at routine whole herd surveillance testing.

Reactor numbers

There was a significant increase in the number of TB reactors from 2017 (391 reactors) to 2018 (758 reactors) and 2019 (738 reactors) which was mainly caused by the extension of mandatory interferon gamma (IFN-γ) testing of Officially TB Free Withdrawn (OTF-W) incident herds to the former HRA portion of Warwickshire. In the 2019, 403 reactors were disclosed by the IFN-γ test and 335 reactors by the skin test.

Risks to the reporting area

Warwickshire is under continuous risk of infection spread from the neighbouring HRA counties of Worcestershire and Gloucestershire. The Edge Area counties of Oxfordshire, Northamptonshire and Warwickshire pose similar risks to one another, as the cross border areas are very similar in terms of cattle density, herd incidence rate and source of infection identified.

Risks posed by the reporting area

Warwickshire is not contiguous with any of the Low Risk Area (LRA) counties and therefore does not pose a risk through local infection spread. However, Rugby cattle market, given its size and location, may well act as a disease dissemination route for cattle from the HRA and Edge Area towards the LRA.

Forward look

Despite a second consecutive annual decrease in the number of TB incidents, 2019 still had the joint third highest number of incidents in the last ten years. The recently enhanced cattle measures support the detection of TB in herds and reduce the potential for lateral spread of infection. The use of biosecurity measures such as informed purchasing of cattle, reduction of cattle-badger interactions and implementation of other wildlife (mainly badger) related measures on-farm are still required to address the most common sources of infection.

Introduction

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

From January 2018 annual routine herd surveillance testing was replaced by six-monthly herd surveillance testing in the whole county of Warwickshire. However since May 2019, cattle herds that meet certain criteria are eligible for annual surveillance testing (earned recognition). These criteria are either: 1) the herd has been in existence for at least six years and has not had a TB incident in that six year period or 2) the herd is registered to a bovine TB health scheme accredited under the Cattle Health Certification Standards (CHeCS) at level one or above. The number of herds granted earned recognition in Warwickshire in 2019 was 213, of which three were due to CHeCS accreditation and the remaining 210 due to being TB free for at least six years.

Cattle industry

Herd types

There is a predominance (47%) of small herds of up to 50 cattle in the county (Figure 1). Beef cattle accounted for 68% of total cattle in the county in 2019, with dairy accounting for 27% and dual purpose 4% (Appendix 2 Table A2.2).

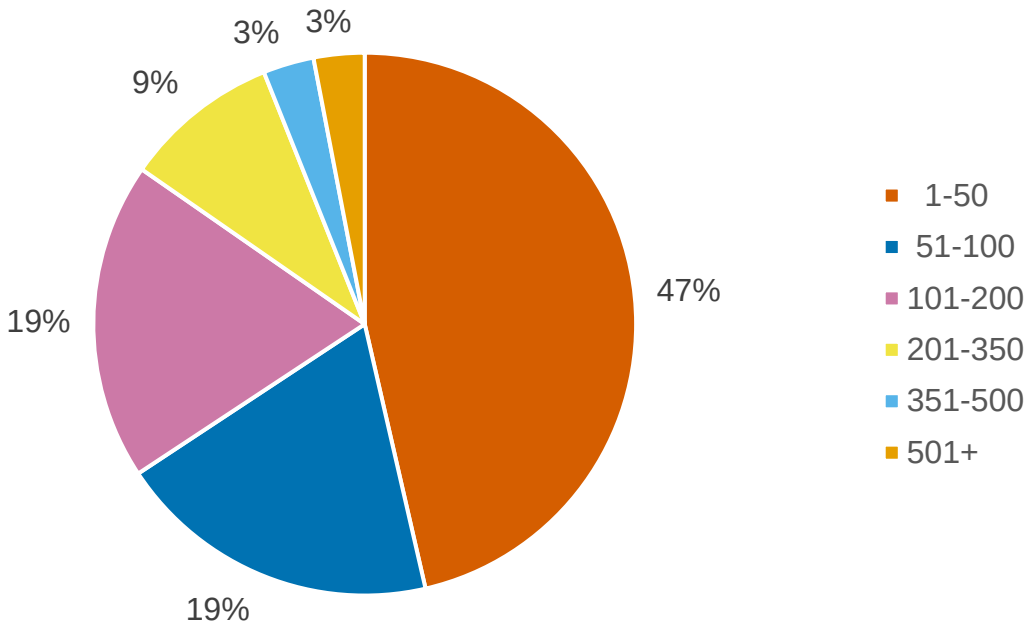

Figure 1: Proportion of cattle holdings by herd size in Warwickshire in 2019 (n=528).

Markets and livestock shows

There is one livestock auction market in Warwickshire; Rugby Farmers Mart, located in Stoneleigh Park Agricultural Centre. The market is not licensed to receive TB-restricted cattle. Local farmers use approved slaughter gatherings (red markets) and dedicated sales for TB-restricted cattle (orange markets) in the neighbouring HRA counties of Worcestershire and Gloucestershire to sell negative-testing cattle from TB-restricted holdings. Four livestock shows took place in the county in 2019.

Approved Finishing Units

One new unit was approved in 2019 giving a total of 14 AFUs in the county. These units are all non-grazing (as required in the Edge Area) and, if correctly operated, are not considered a risk for introduction or spread of TB into the surrounding areas.

There are no Pre-movement Testing Exempt Finishing Units (EFU) in the county.

Common land

No grazing of common land by cattle herds is being practiced in Warwickshire.

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

As illustrated by Figure 2, the annual number of new TB incidents shows a fluctuating pattern with an overall rising plane over the last ten years. A drop in the number of new TB incidents occurred in 2018 and 2019 compared with 2017. In 2017, the number of new incidents was the highest (83), followed by 80 in 2018 and 68 in 2019. There is a small difference in the number of Officially TB Free Suspended (OTF-S) incidents over the last three years but Officially TB Free Withdrawn (OTF-W incidents are decreasing.

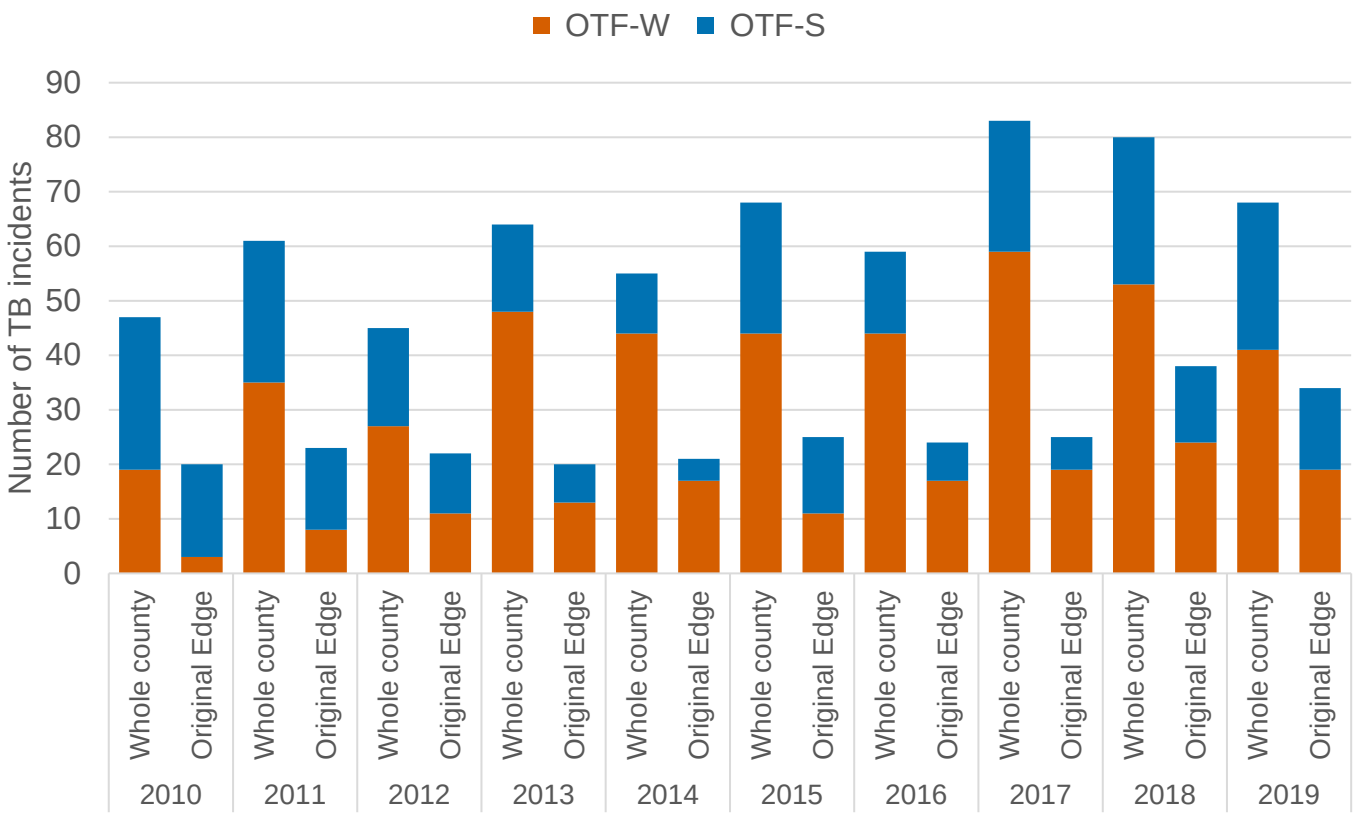

Figure 2: Annual number of new TB incidents in Warwickshire, 2010 to 2019, showing incidents for the whole county and the original Edge Area.

In 2018 annual routine surveillance testing was replaced by six-monthly testing in the whole county. Despite the expectation that the increased testing frequency would result in an increased number of new incidents and increased incidence rate in 2019, the data shows the opposite. This could be an early indication that the additional cattle control measures introduced in 2017 and 2018 are having the desired effect. However further monitoring is needed to be able to draw this conclusion with confidence, as the number of new incidents in 2019 is still the joint third highest over the last ten years.

Following reclassification of the whole county of Warwickshire as Edge Area, mandatory IFN-γ testing was applied to all new OTF-W incidents. Application of the IFN-γ test improves overall test sensitivity, leaving behind fewer animals with undetected infection. In addition, skin test sensitivity has been increased by the application of severe interpretation to all new incidents. These measures are likely to reduce the number of new incidents in the medium and long term by reducing TB spread within and between herds, lowering the rate of recurrence and decreasing the chances of exposing wildlife to infection.

The decrease in the number of TB incidents could also be related to the overall reduction in the number of cattle herds from 567 in 2018 to 528 in 2019.

Another factor contributing to the lower incident numbers could be improvements to on-farm biosecurity implemented by cattle owners. The TB Advisory Service (TBAS, www.tbas.org.uk/) offers farmers in the Edge Area free bespoke advice visits on TB related biosecurity. The TB hub website

(https://tbhub.co.uk/) has also increased farmers' awareness of the disease and biosecurity standards.

Figure 2 also illustrates that over the last three years, the number of new incidents in the original Edge Area portion of the county fluctuated while incidents in the whole county have reduced over three consecutive years.

Annual TB incidence per 100 unrestricted herds (Figure 3) in the whole county of Warwickshire has fluctuated over the past 10 years. There has been an overall rising plane from 8.5 in 2010 to 14.9 in 2018 and then a drop from 14.9 to 12.9 between 2018 and 2019, respectively. Figure 3 also illustrates TB incidence per 100 herd-years at risk. The pattern is also fluctuating with a rising plane from 8.1 in 2010 to a peak of 16.8 in 2019. The denominator for this incidence rate measure (herd-years at risk) is sensitive to changes in testing intervals within an area. This should be borne in mind when considering incidence rate trends in some parts of the Edge Area that moved from annual to six-monthly testing in 2018. A detailed description of the methodology used to calculate incidence per 100 HYR is available in the Explanatory Supplement for 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

Figure 3 shows that the annual incidence per 100 unrestricted herds in the original Edge Area portion of the county was relatively stable between 2010 and 2017. However there was a sharp rise in 2018 to 11.4 and maintained in 2019 (10.4). The annual incidence per 100 herd-years at risk followed a similar trajectory from 2010 until 2019 when incidence continued to rise to a peak of 13.4.

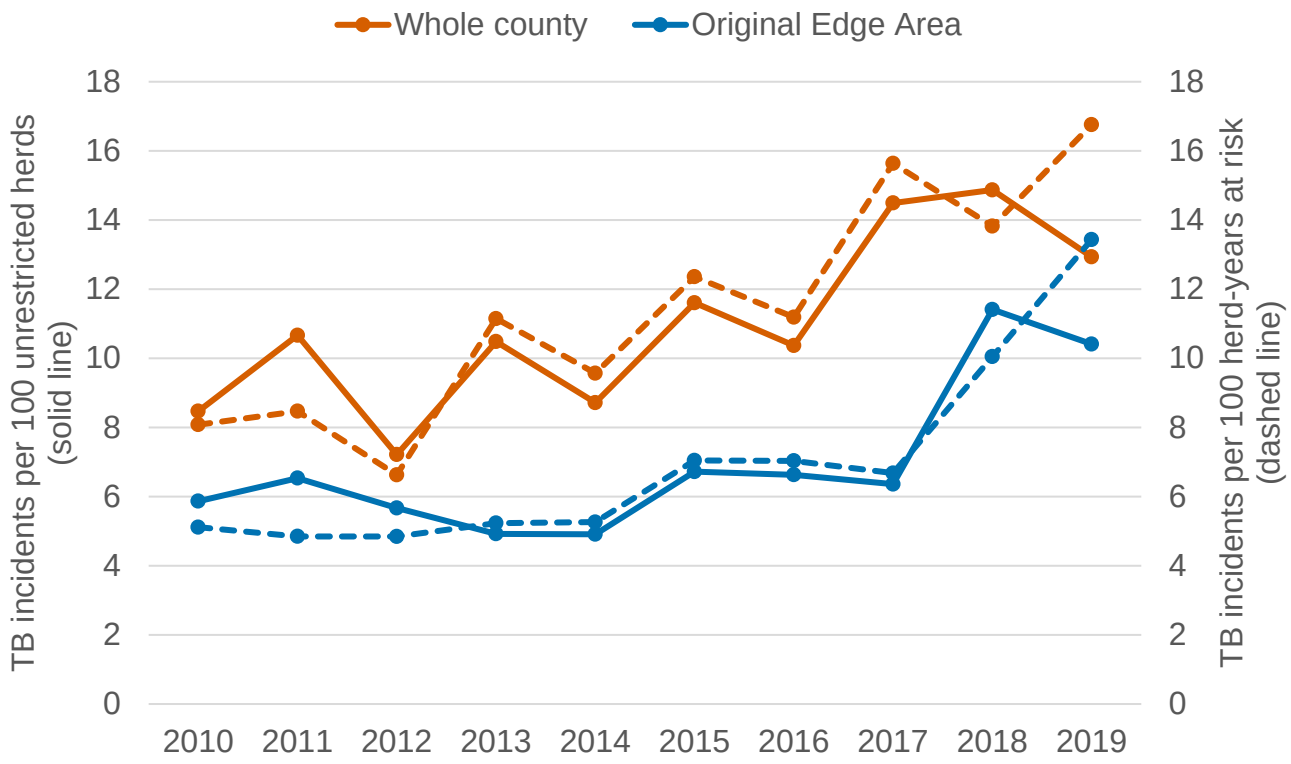

Figure 3: Annual herd incidence rate (per 100 herd-years at risk and per 100 unrestricted herds) for all new incidents (OTF-W and OTF-S) in Warwickshire, 2010 to 2019, showing data for the whole county and for the original Edge Area.

Figure 4 illustrates the percentage of herds in Warwickshire which were under TB restrictions at the end of 2019. This includes herds which had restrictions imposed on them in 2019 as well as those which were restricted prior to 2019 but had not achieved OTF status by the end of 2019. The duration of TB incidents will have a direct effect on prevalence. The longer the incidents the higher the prevalence.

At the end of 2019 the proportion of restricted herds was 9.28%, which is 1.5% lower than in the previous year. However there has been a trend of increasing herd prevalence over the last 10 years.

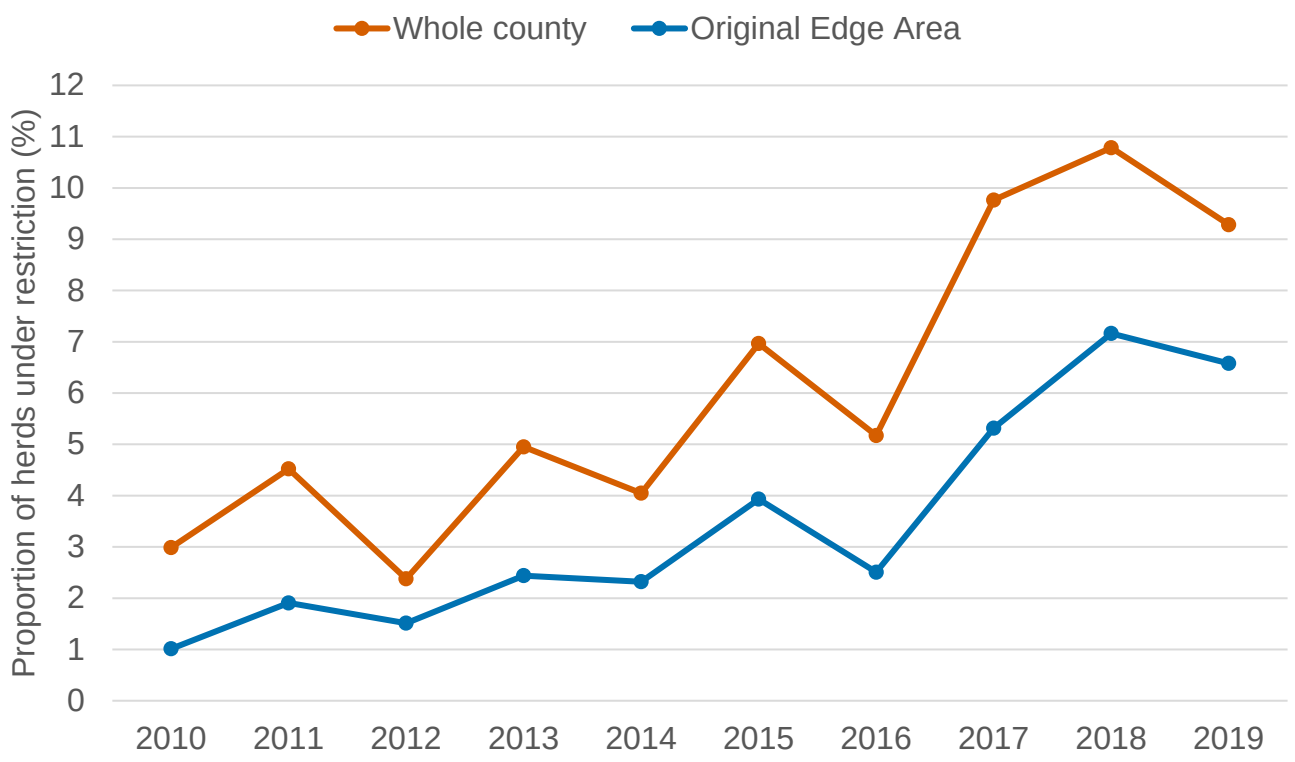

Figure 4: Annual end of year TB herd prevalence in Warwickshire, 2010 to 2019, showing data for the whole county and for the original Edge Area.

Prolonged incidents and increased herd prevalence is related to endemicity of the disease, especially in areas of Warwickshire previously classed as HRA. Difficulties in breaking wildlife related risk pathways often result in repetitive reinfection of cattle and prolonged or recurrent incidents. Residual infection within a herd may also increase the duration of an incident, hence the application of more sensitive testing such as interferon gamma testing.

The sharper increase in herd prevalence observed in 2017 could be attributed to the changes made in relation to scheduling of incident testing. Short interval tests are scheduled to occur at a minimum of 60 days from reactor removal (as opposed to 60 days from reactor disclosure and isolation). This policy change may have an impact on the duration of all incidents.

Geographical distribution of TB incidents

As shown in Figure 5, Warwickshire's incidence rate of 17.0 incidents per 100 herd-years at risk, is equivalent to the overall average HRA incidence rate in 2019 (16.9). It is therefore well above the overall average incidence rate in the Edge Area (9.9).

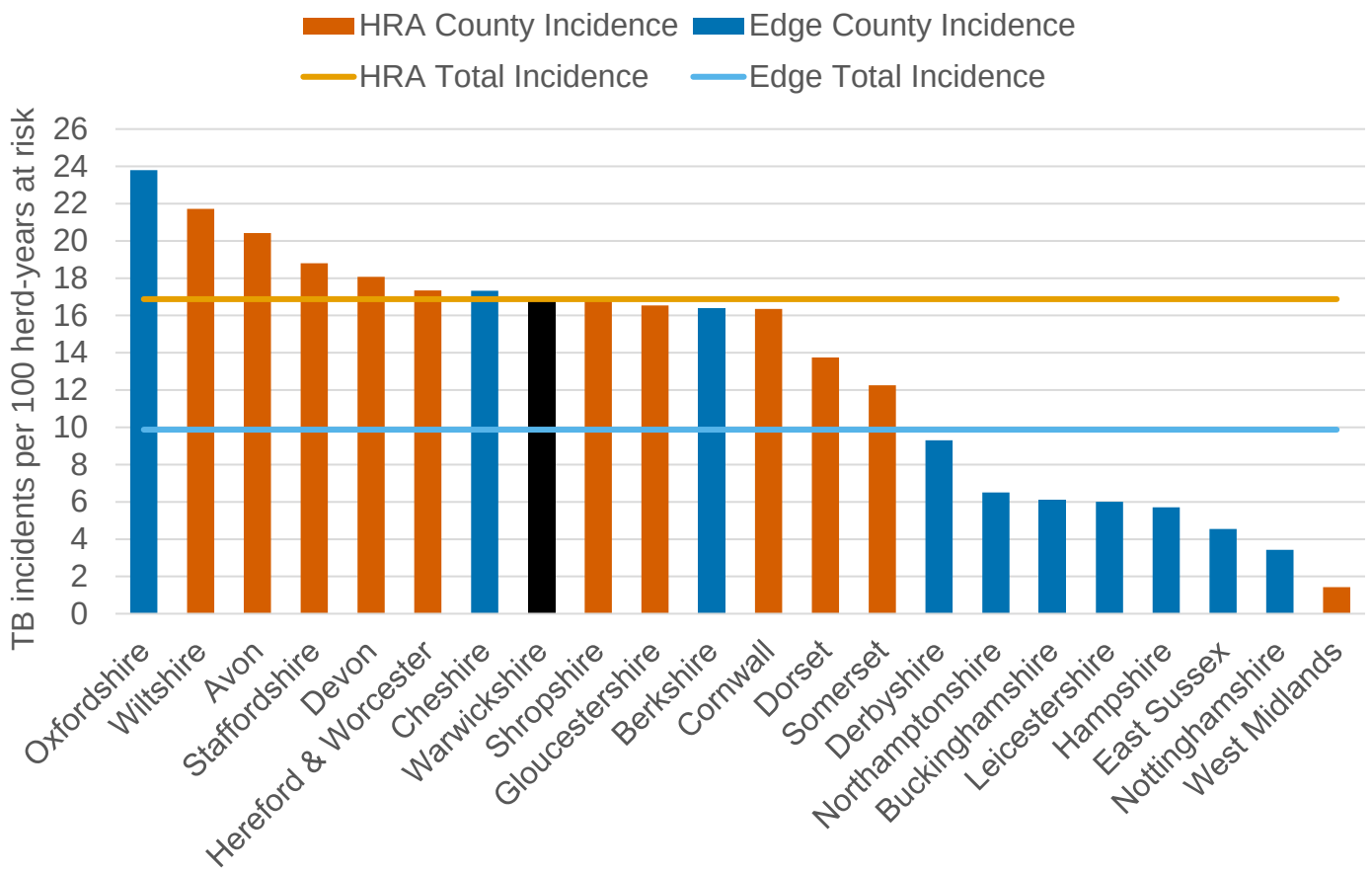

Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in 2019, by HRA and Edge Area county.

The geographical distribution of new TB incidents in 2019 and pre 2019 OTF-W ongoing incidents with their associated spoligotypes is illustrated in Figure 6. Previously, the former HRA portion of the county in south-west Warwickshire had a higher number of incidents than the rest of the county. However in 2019, the number of incidents in the former HRA portion has decreased and this difference is now less evident. Higher numbers of incidents are observed in areas of higher holding and cattle density however this is less evident on the Leicestershire border. There are also more incidents along the border with the HRA counties of Worcestershire and Gloucestershire as the disease creeps towards the north-east. More incidents are also seen along the borders of Oxfordshire and Northamptonshire (both within the Edge Area). The reasons for this are described later in the report.

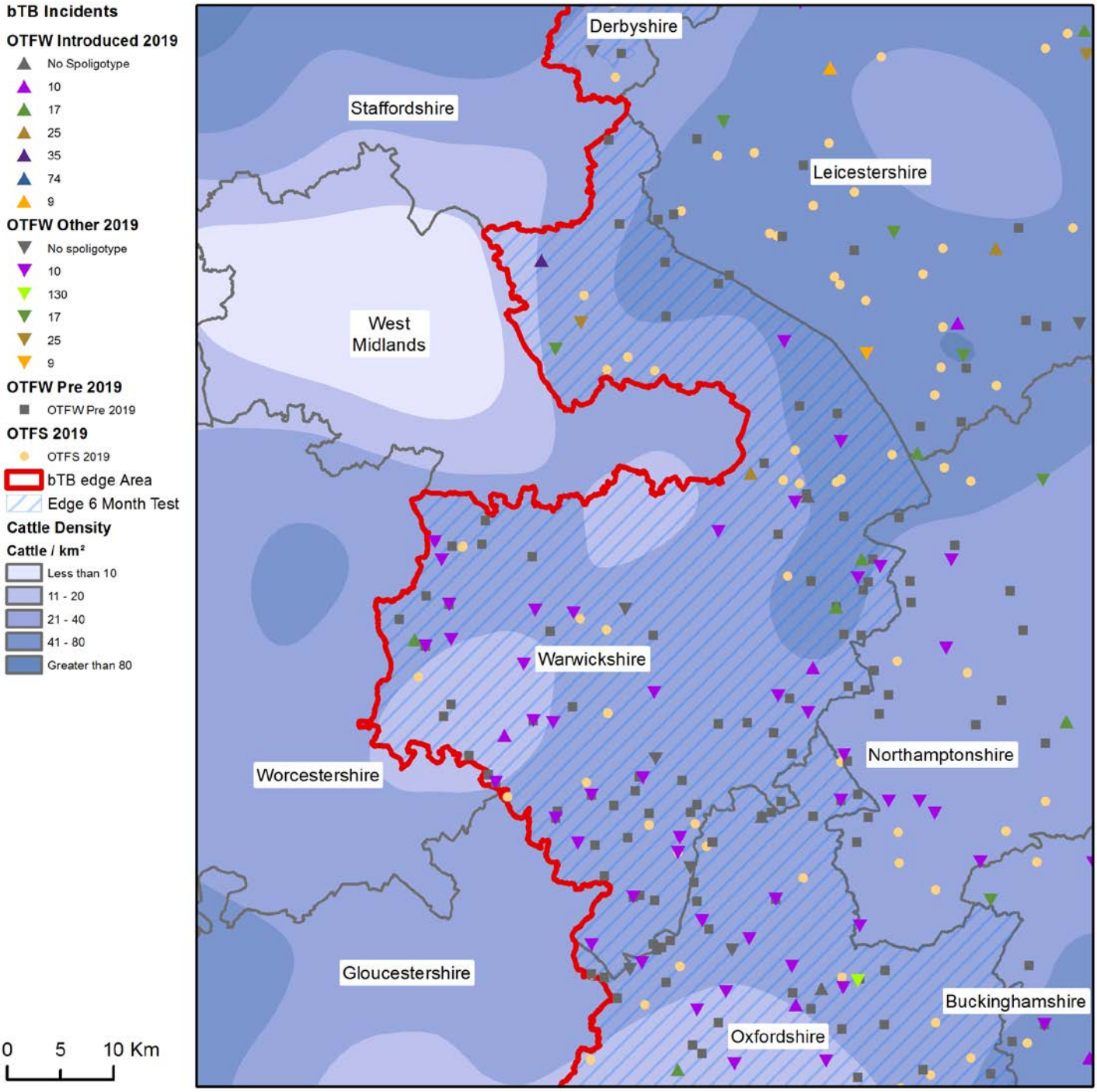

Figure 6: Location of cattle holdings in Warwickshire with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the beginning of 2019, overlaid on a cattle density map. To note, 'OTF-W Introduced 2019' refers to OTF-W incidents in which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

Badgers and wild deer can act as reservoirs of *M. bovis* and both species are reported to be very active in certain parts of the county. Warwickshire has 65 nature reserves and several large farming estates providing a suitable habitat for badgers as well as deer. The Woodland Trust's woodlands cover 480 hectares over 18 sites. Suspicion of *M. bovis* infection within populations of wildlife is a first indication of the disease becoming endemic in the area.

Figure 7 shows higher TB incidence in the former HRA of Warwickshire and a lower incidence in areas above the M40 and M6 motorways. It indicates that major roads may serve as barriers to wildlife migration and therefore slow disease spread. It is difficult to make a comparison of behaviour of these incidents with previous years as the epidemiology reports for this part of the county (former HRA) only go back to 2018.

However, it is evident that certain *M. bovis* genotypes tend to form clusters even when observed on a single year basis (Figure 7). This is an indication of local spread which could be due to direct contact between cattle from different herds or from wildlife contact, given the widespread geographical dispersion of certain genotypes and rare reports of neighbouring cattle having contact with each other.

Figure 8 illustrates distribution of incidents in 2019 and the source pathway recorded as most likely. The south west of the county (former HRA) is dominated by incidents attributed to wildlife while in the rest of the county there is a mixture of incidents attributed to wildlife and movement of cattle. Again, the number of incidents is lower in areas above the M40 and M6 motorways.

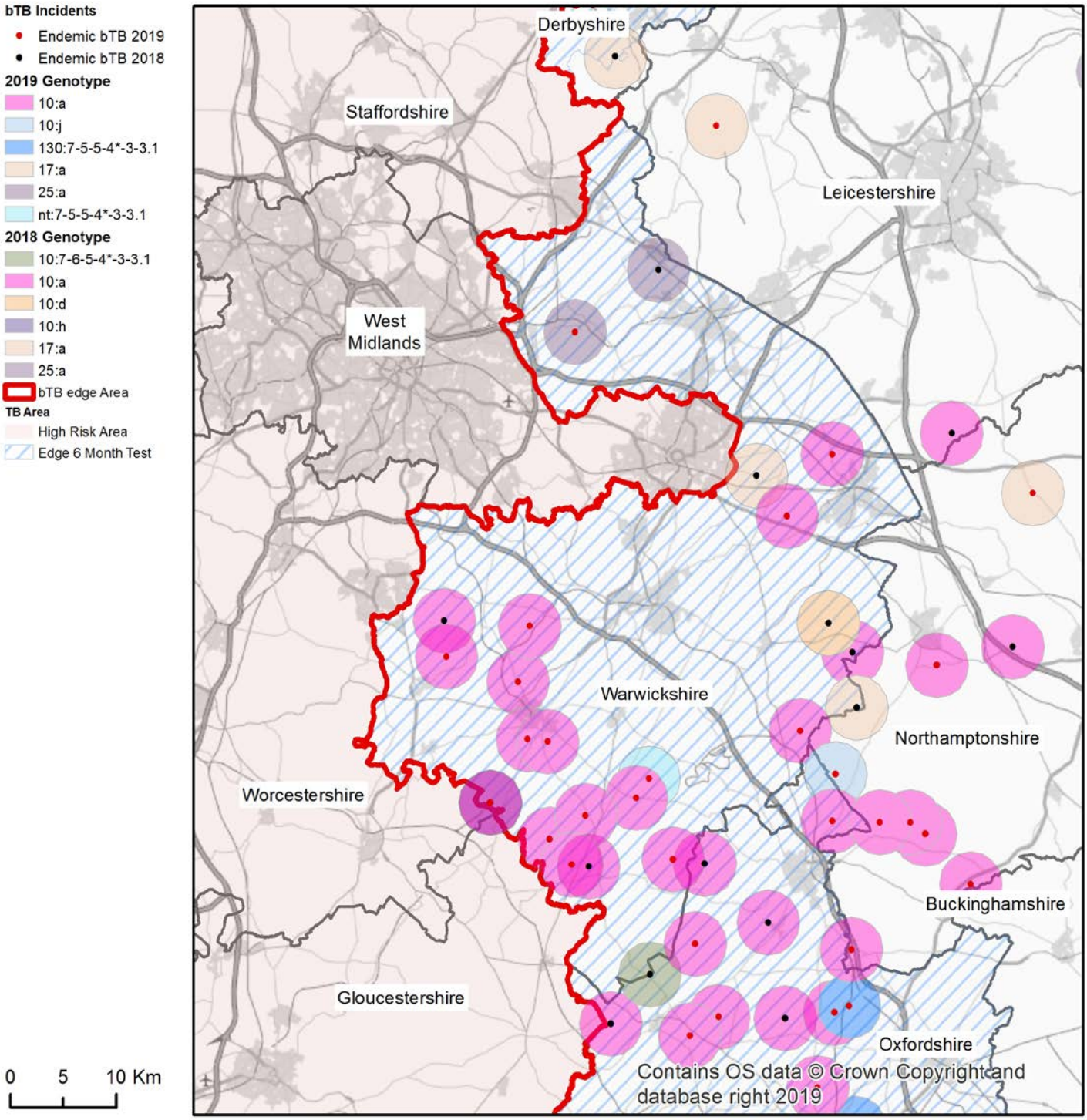

Figure 7: Genotypes of *M. bovis* detected in Warwickshire in 2018 and 2019, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemic infection within local wildlife populations (OTF-W incidents only).

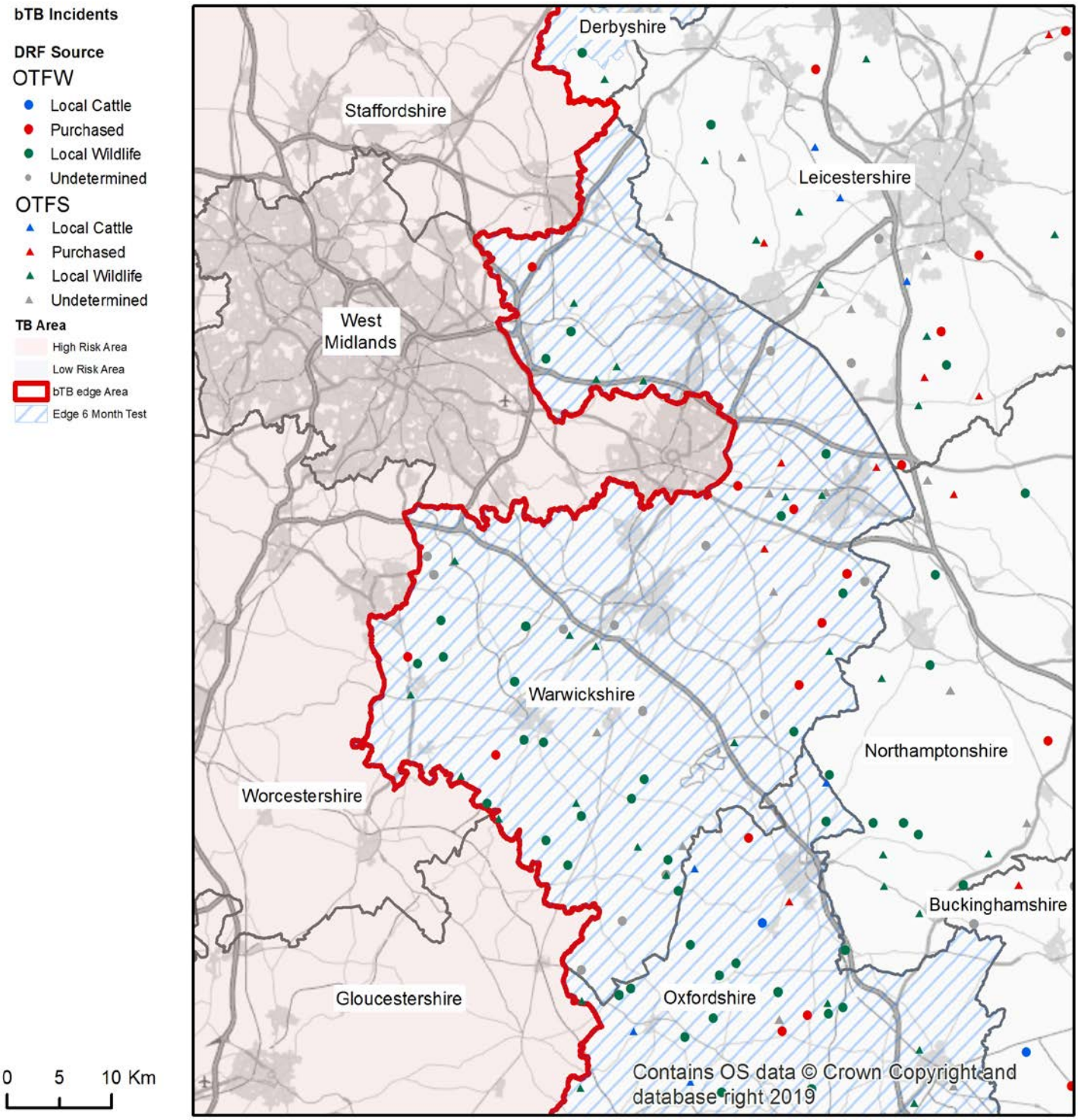

Figure 8: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Warwickshire, and its adjoining Edge Area counties, which started in 2019.

Other characteristics of TB incidents

Incidents by herd types

Incidents were more common in all herd sizes up to 350 cattle (Figure 9). However, despite a predominance of small herds (1-50 cattle) in Warwickshire (Figure 1 and Appendix 2 Table A2.1) only 5.7% of these herds were infected compared to 15.6% of small/medium herds (51-100 cattle), 17% of medium herds (101-200 cattle) and 32% of medium/large herds (201-350 cattle). Infection was detected in 25% of all large herds (351-500 cattle) in 2019. This clearly indicates that the risk of infection increases with the size of the herd.

Beef herds accounted for the majority of incidents in 2019, a reflection of the fact that beef cattle are the predominant herd type in Warwickshire.

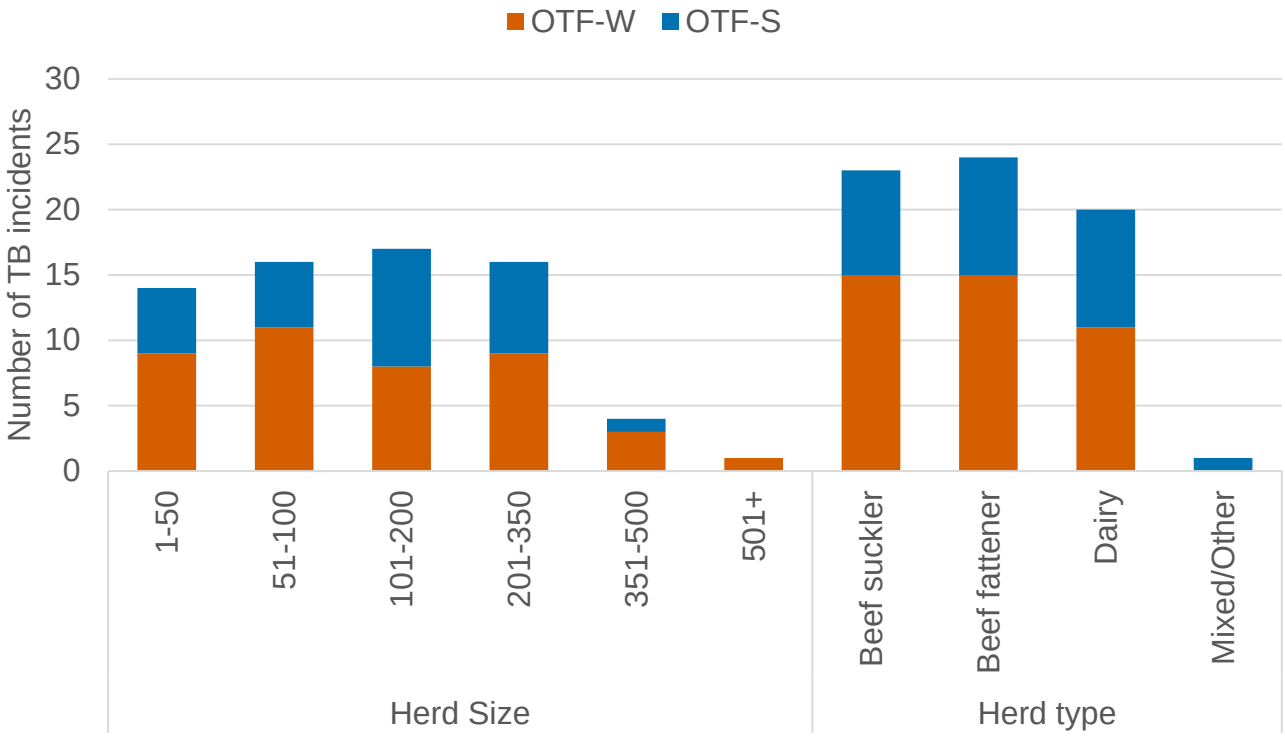

Figure 9: Number of new TB incidents (OTF-W and OTF-S) in Warwickshire in 2019, by cattle herd size and type.

Incidents by month of disclosure

As shown in Figure 10, most incidents were disclosed in March (nine cases) and October (also nine cases). This can be explained by farmers' preference to undertake routine surveillance testing either before turning cattle out to grass in early spring or after cattle finish their grazing season in autumn. Another reason for this pattern could be that cattle-to-cattle transmission of TB is likely to increase during winter months when the animals are housed and are in closer contact with each other. The autumn peak could also be related to the fact that more cattle-badger interactions may take place in the summer during the grazing period.

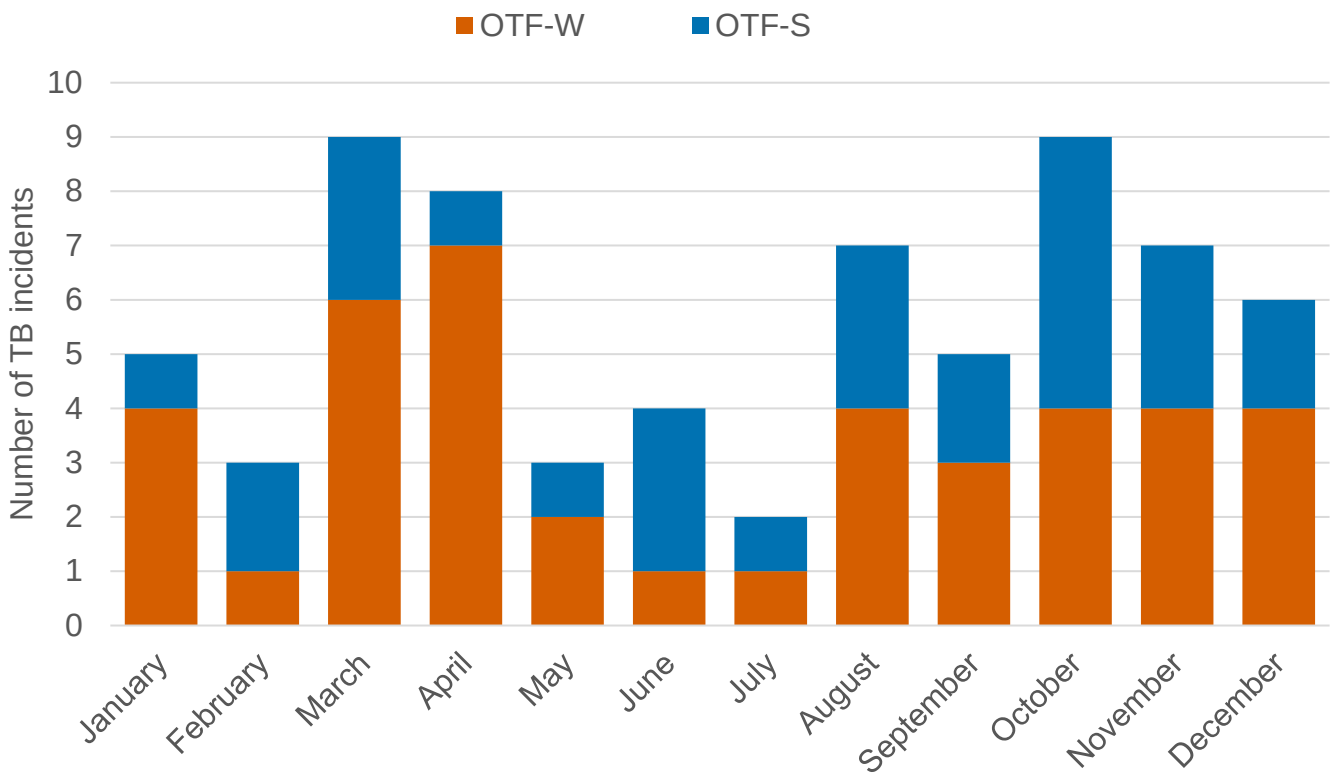

Figure 10: Number of new TB incidents (OTF-W and OTF-S) in Warwickshire in 2019, by month of disclosure.

Genotypes of *M. bovis* isolated

To characterise the strain of TB infecting an animal, APHA laboratories carry out DNA typing of *M. bovis* isolates. The most common genotype in Warwickshire is 10:a (Figure 11). This genotype was found in 30 incidents (81%). It is also very common in the neighbouring counties of Worcestershire, Gloucestershire and Oxfordshire. As seen in Figure 7, genotype 10:a was isolated in most of the cases that were 'most likely' attributed to wildlife. Genotype 17:a is the second most common, but much less numerous, genotype in comparison with genotype 10:a. There were three cases of genotype 17:a in 2019 and the most likely source of infection for all three were animals purchased from the HRA.

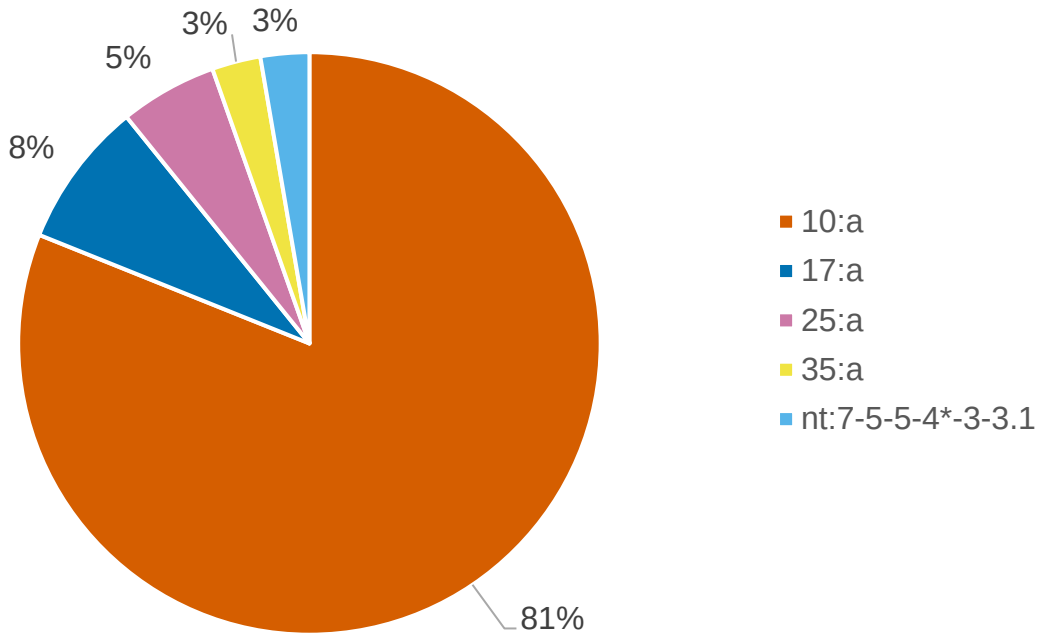

Figure 11: Genotypes of *M. bovis* (OTF-W only) identified in herds with OTF-W incidents in in Warwickshire in 2019 (n=37).

Duration of incidents

The majority of all TB incidents resolved in 2019 had lasted between 151 and 240 days (Figure 12). Herds in which movement restrictions exceed 551 days (18 months) are classed as persistent incidents. Nine herds were known to be persistently infected in 2019, of which four resolved during the course of the year and five continued to be persistently infected. Eight out of nine persistent incidents were OTF-W status. One herd achieved OTF status in 2019 after being under restrictions for over five years. There was also one OTF-W incident herd which resolved in 2019 which was very close to being classed as persistent at 550 days duration.

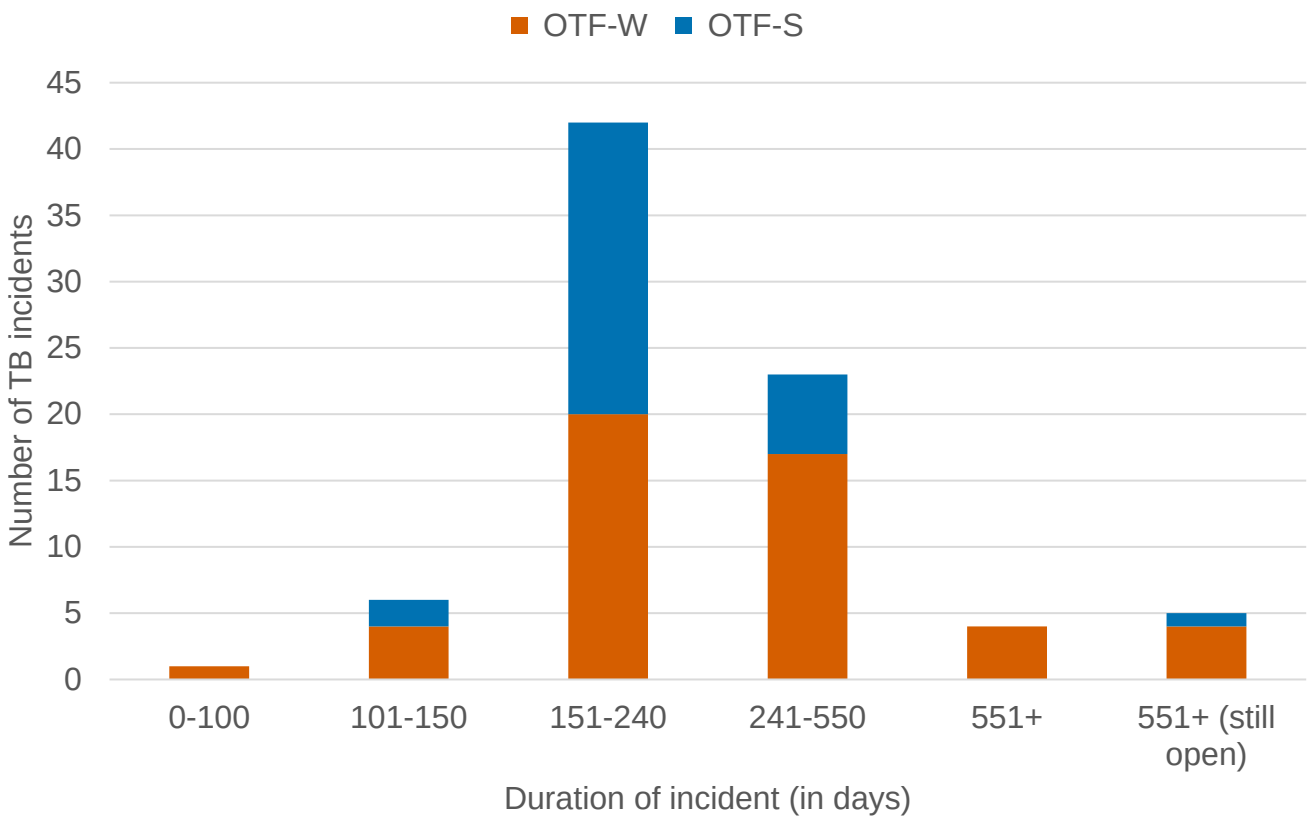

Figure 12: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Warwickshire. Note that Approved Finishing Units (AFUs) have been excluded.

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 Warwickshire are as follows:

- Infected wildlife
- Cattle movements

Sources of infection and risk pathways

According to the assessment described above and illustrated in Figure 13a and Figure 13b, for new TB incidents in Warwickshire in 2019, badgers were the highest weighted source pathway attributed for both OTF-W incidents (46.35%) and OTF-S incidents (55.46%). Overall this give a 50.33% weighting to badgers, and includes cattle exposed at grazing as well as at housing (Appendix 4). This figure is lower than last year's overall figure where 60.23% of weighted source pathways were attributed to badgers. The reason for this nearly 10% decrease may be partly due to a revised mathematical algorithm used to determine the relative contribution of different sources for each incident this reporting year rather than a genuine decrease in badger to cattle transmission.

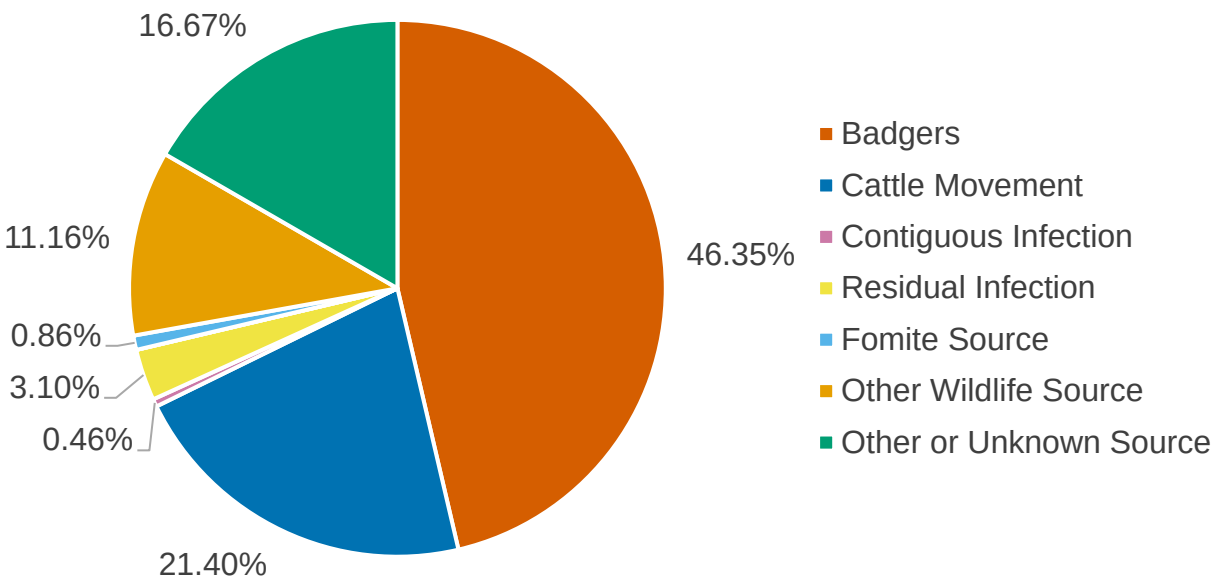

Figure 13a: Summary of the weighted source of infection pathways attributed for OTF-W incidents in Warwickshire that started in 2019, that had a completed DRF (36).

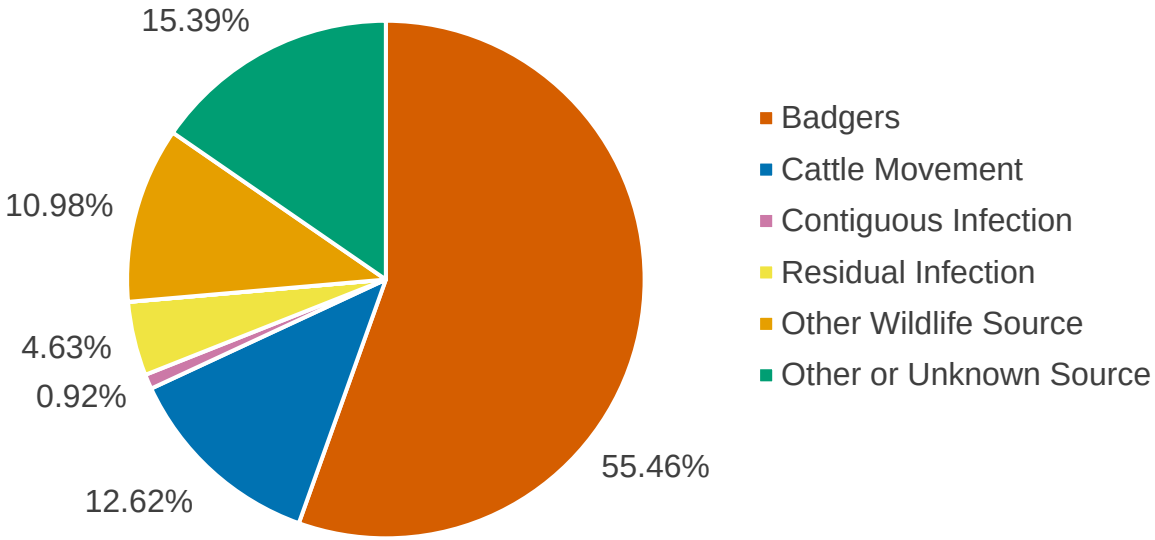

Figure 13b: Summary of the weighted source of infection pathways attributed for OTF-S incidents in Warwickshire that started in 2019, that had a completed DRF (28).

Figures 13a and Figure 13b should be considered in conjunction with Figures 7 and 8. Appendix 4 provides the combined weighted source pathway data for all incidents (OTF-S and OTF-W) disclosed in 2019). The high weighted proportion of pathways which identified badgers as a likely source of

infection (50.33%), indicates their likely importance in TB infection in cattle in the county. Other wildlife species such as wild deer play a role too with an 11.08% weight over all pathways.

As described above (Geographical Distribution of TB Incidents), wildlife populations are reported to be very active in certain parts of the county; there are numerous woodlands and nature reserves which are a good habitat for badgers and deer. Wild deer surveillance is carried out by private stalkers who are required to report any TB-like lesions in deer to APHA who will arrange for those lesions to be cultured. There were no *M. bovis* confirmed cases in deer in 2019.

Warwickshire shares its boundaries with the HRA counties of Worcestershire and Gloucestershire. There has been a tendency for disease to spread in a north-easterly direction into Warwickshire from these counties.

Strict biosecurity measures are necessary to prevent cattle-badger contact and reduce this significant risk pathway. The TB Advisory Service (TBAS, www.tbas.org.uk/) offers farmers free bespoke advice visits on TB related biosecurity including advice on limiting contact between cattle and badgers.

Of the source pathways recorded, cattle movement had an overall weighted proportion of 17.56% which makes it the second most likely source and an important driver of the epidemic. As Warwickshire being contiguous to the HRA along its western boundary (Staffordshire, West Midlands, Worcestershire and Gloucestershire), it is to be expected that cattle movement would be a source of TB infection as many farmers source their cattle locally from neighbouring counties.

An industry led TB health scheme accredited by the Cattle Health Certification Standards (CHeCS) was established in 2016 to encourage farmers to minimise risk when buying cattle. The TB Advisory Service (TBAS, www.tbas.org.uk/) puts considerable emphasis on responsible cattle purchasing practices during their advisory visits. Another tool introduced to encourage safe sourcing of cattle is the interactive mapping tool, ibTB (www.ibtb.co.uk) showing the location of current and historic TB incidents over the last 10 years. The APHA Farm Level TB reports issued to farmers during incidents are also useful as they help to demonstrate the risk related to purchasing cattle for individual farmers.

The weighted proportion of source pathways that were unknown or uncertain was 16.11%, whilst the weighted proportion of pathways assigned to residual infection was 3.77%. Residual infection within a herd is caused by a failure to detect every infected animal. By applying the IFN-γ test together with the skin test, the overall sensitivity of the test is increased. The remaining possible TB sources, with much lower occurrence, are contiguous herds 0.66% and fomites 0.48%.

The most common source of infection recorded with the highest level of certainty was wildlife for both beef (suckler and fattening) and dairy herds (Figure 14).

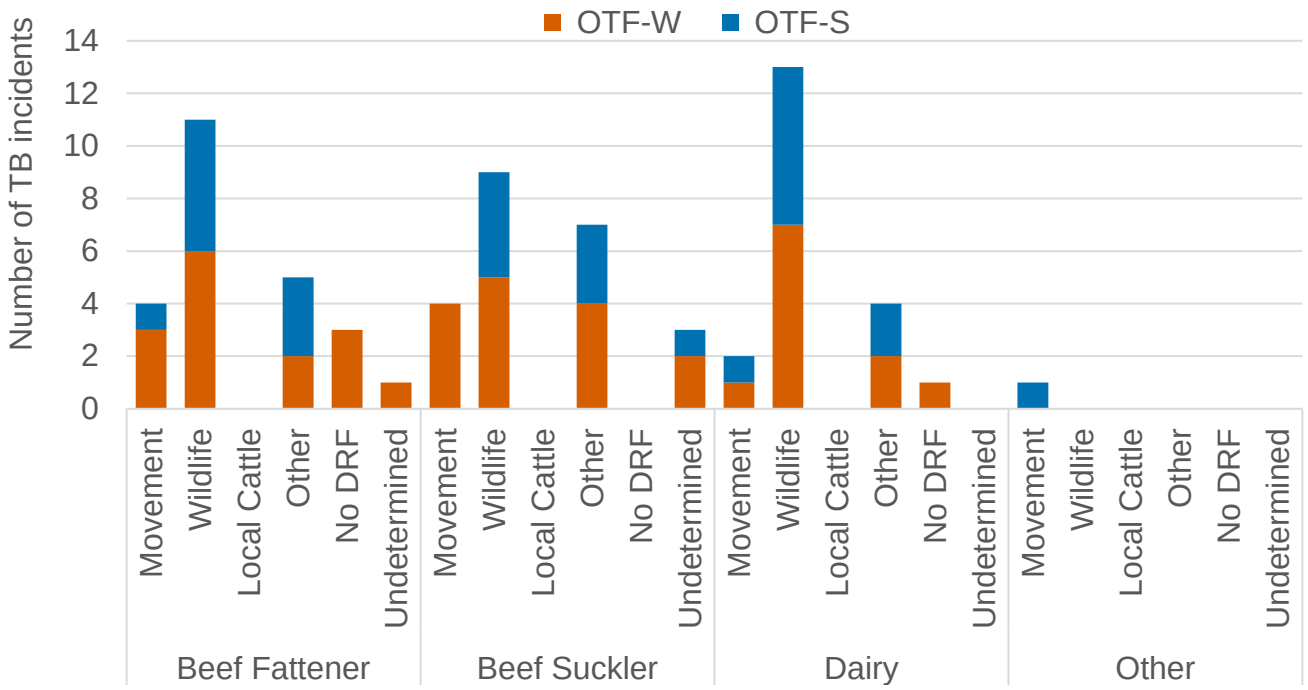

Figure 14: Source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in Warwickshire in 2019, by herd type. Note that the categories 'movement', 'wildlife', and 'local cattle' are comprised of incidents where these were the most likely single source of infection recorded. Incidents where the most likely single source was stated as 'unknown' were assigned to the category 'undetermined'. 'Other' includes incidents where there was equal weighting between the most likely sources of infection as well as other pathways not categorised elsewhere.

TB in other species

There is no statutory routine TB surveillance of non-bovine species, apart from post mortem examination (PME) of suspected clinical cases reported to APHA and post mortem meat inspection of animals (e.g. sheep, goats, pigs) slaughtered for human consumption.

The significance of badgers and deer in *M. bovis* transmission was explained in the section above (Risk Pathways and Key Drivers for TB Infection).

Although badgers and, to a lesser degree, deer are a suspected source of many TB incidents in cattle, there has been no laboratory confirmed isolation of *M. bovis* in 2019 in the county for these wild animals, neither for any domestic or farmed non-bovine species.

In 2019, an area of 1.3 km^2 was licenced for badger vaccination and 20 badgers were vaccinated.

Detection of incidents

The majority of TB incidents (40 out of 68) were disclosed by routine whole herd surveillance testing (WHT) as shown in Figures 15a and 15b below. In 2018, the routine surveillance testing interval frequency changed from 12 to six months. This change was introduced after the completion of herds` annual routine tests for 2018 so 2019 was the first full year of implementation of six-monthly testing.

Figure 15b illustrates the change, as the increase in incidents disclosed by WHT was seen in 2018 and 2019.

The second most frequent type of test disclosing TB reactors was the 6M test carried out six to eight months after conclusion of an incident. Seventeen incidents in 2019 were disclosed at a 6M test; an increase in number and proportion on 2018 (Figure 15b).

The reason for herds experiencing recurrence of infection at the 6M test is not only residual infection within a herd caused by a failure to detect every infected animal, but also inability to eliminate the sources of infection which could lead to another incident. This is particularly relevant in counties where the disease is endemic. It is expected that application of the IFN-γ test will help detection of infected animals missed by the skin test and as a result limit the number of herds suffering recurrent incidents.

Post mortem meat inspection of cattle from OTF holdings at slaughterhouses (SLH) disclosed five out of 68 incidents in 2019. Pre movement testing (PRMT) disclosed four incidents and New Herd Check Testing (CT-NH) two incidents.

Following the introduction of the six-monthly WHT in 2018, contiguous herds tests (CON) and 12M tests no longer take place.

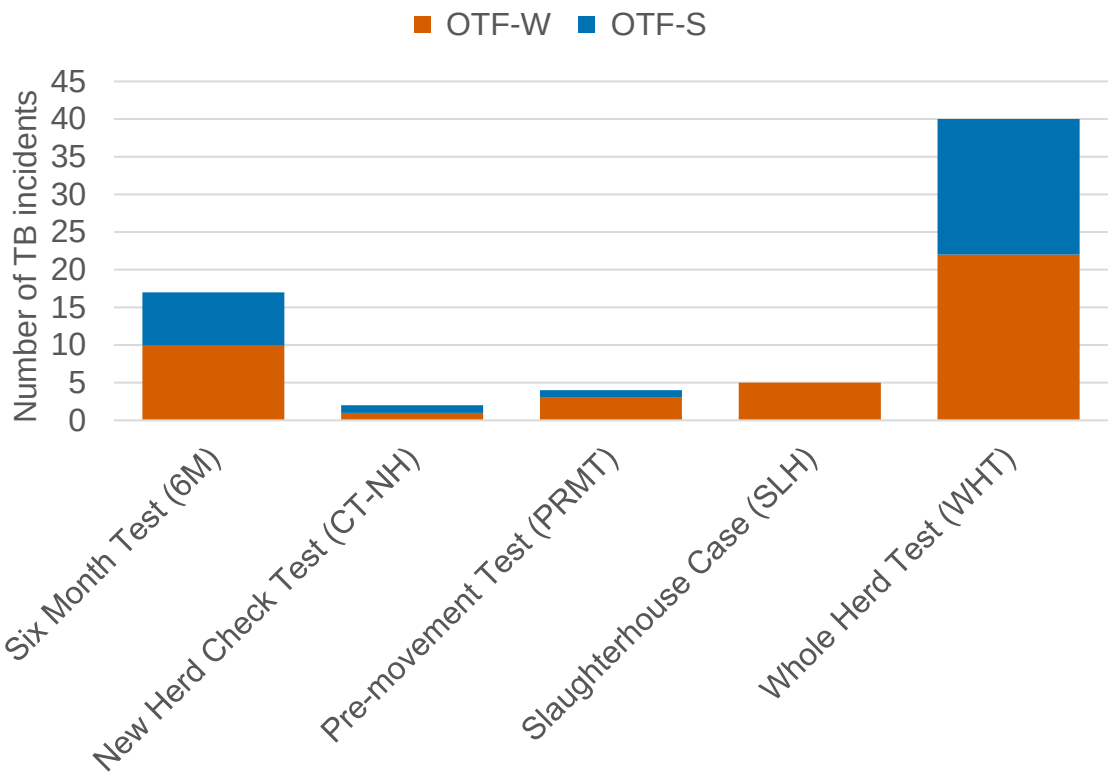

Figure 15a: Number of TB incidents (OTF-W and OTF-S) in Warwickshire in 2019, disclosed by different surveillance methods.

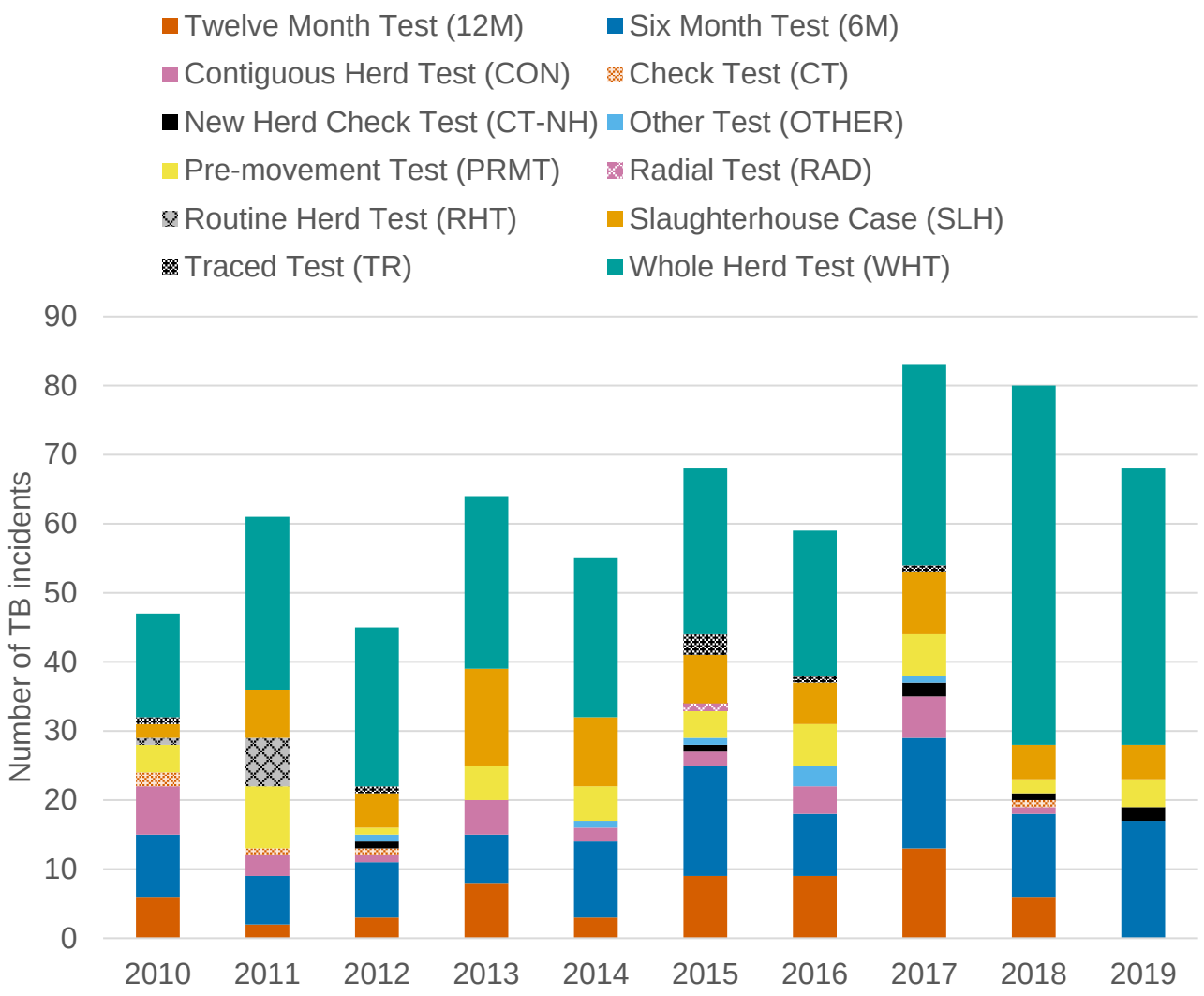

Figure 15b: Number of TB incidents (OTF-W and OTF-S) in Warwickshire, 2010 to 2019, disclosed by different surveillance methods by year.

Nearly half of all incidents in 2019 (32 cases) had experienced a TB incident in the previous three years (Figure 16).

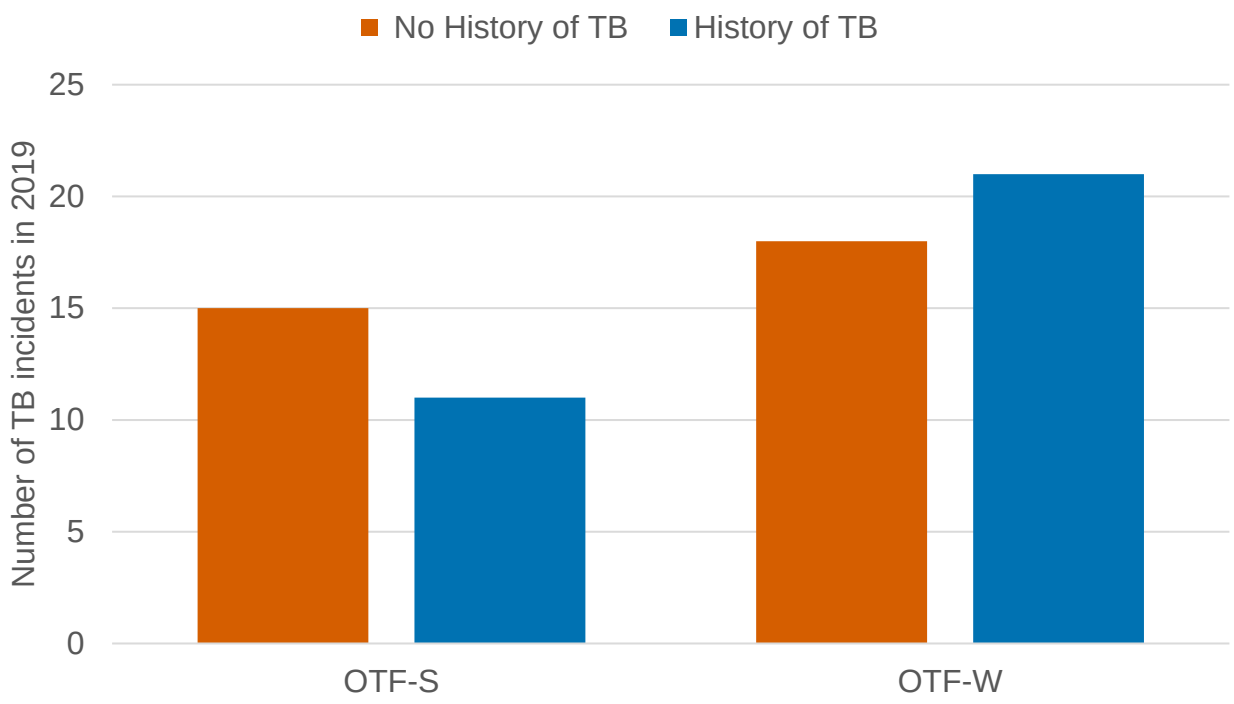

Figure 16: Number of TB incidents (OTF-W and OTF-S) in Warwickshire in 2019 on holdings that have suffered an OTF-W incident in the previous three years, and holdings with no history of TB in the previous three years.

Skin test reactors and interferon gamma test positive animals removed

TB in cattle represents a significant and increasing burden in Warwickshire for farmers, taxpayers and APHA. Many farmers are forced to change their farm management while under movement restrictions in order to minimise losses to the business and prevent welfare issues. After losing animals due to TB controls dairy farmers can struggle to meet their milk quota. Restocking can also be challenging for both dairy and beef sectors as responsible sourcing of animals becomes more difficult.

One of the measures of TB burden is the number of reactors removed for TB control purposes. Figure 17 shows the number of both skin test reactors and IFN-γ test positive animals removed in Warwickshire from 2010 to 2019.

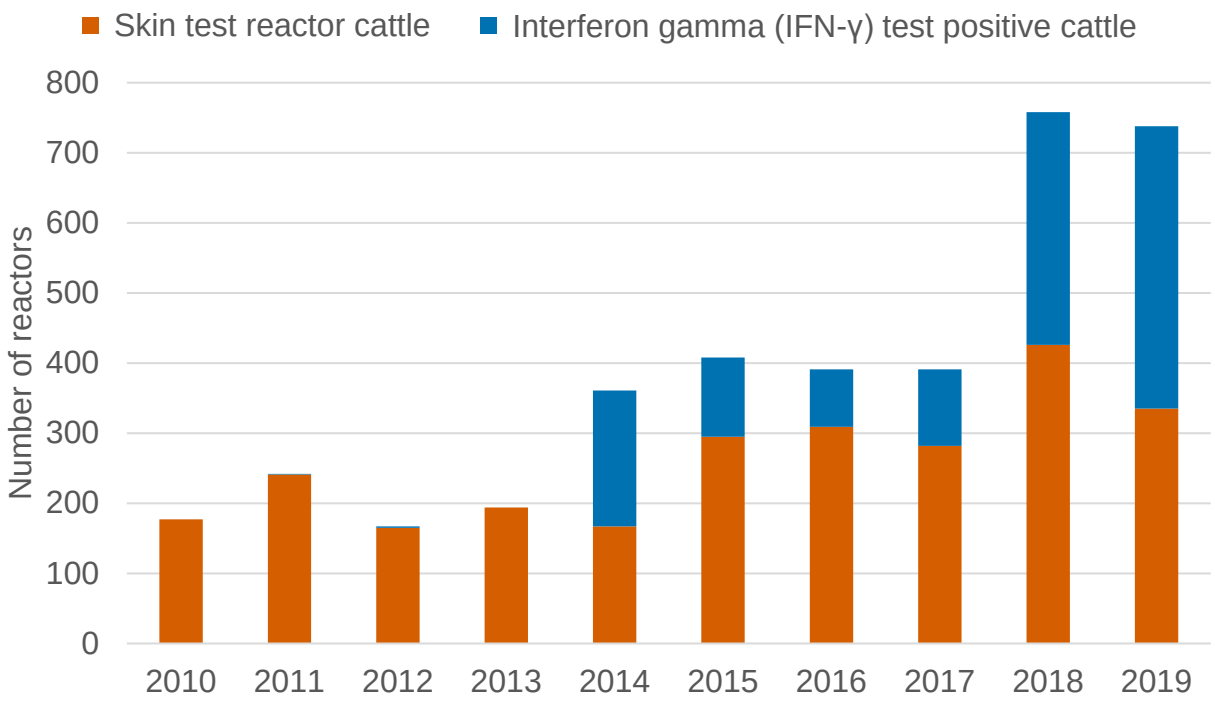

Figure 17: Number of Skin test reactors and Interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Warwickshire, 2010 to 2019.

There is a clear rise in the annual number of reactors removed since 2014 and it is related to establishment of the Edge Area in 2013 and associated enhanced control measures. In 2014 the number of reactors almost doubled due to the introduction of compulsory IFN-γ testing of new OTF-W incident herds. Another significant increase was seen in 2018, when again the number of reactors nearly doubled in comparison to 2017. This was due to incorporation of the former HRA part of Warwickshire into the Edge Area and wider application of IFN-γ testing.

In 2019, a total of 738 TB reactors were slaughtered in Warwickshire at an average of 10.8 reactors per incident. IFN-γ test-positive animals accounted for 55% (n=403) of all reactors and 45% (n=335) were skin test reactors. The total number of reactors decreased by 20 when compared with 2018.

Summary of risks to Warwickshire

With Warwickshire being contiguous to the HRA along its western boundary, the county is at a constant risk of infection creep, the most risk coming from Worcestershire and Gloucestershire. Only the urban areas of the West Midlands, with lower cattle density, give some protection to the western border of Warwickshire. Apart from the holdings at the borders of the county being exposed to the same wildlife reservoir as the HRA holdings, movements of cattle from these HRA counties is not uncommon. The increasing number of AFUs in Warwickshire hopefully mitigates the risk related to movements as undetected infected cattle are directed into biosecure units and can only move to slaughter.

Wooded areas on the Oxfordshire border provide a suitable habitat for badgers and wild deer with pockets of suspected endemicity. Oxfordshire had a higher herd incidence and prevalence than Warwickshire therefore is the most risky neighbour from the Edge Area counties.

Summary of risks from Warwickshire to surrounding areas

Warwickshire is not contiguous to any of the LRA counties and therefore it does not pose a direct risk through local infection spread. However, Rugby cattle market, given its size and location, may well act as a disease dissemination route for cattle from the HRA and Edge towards the LRA.

As mentioned before, the large and busy M40 and M6 motorways serve to some degree as a physical barrier for wildlife and could mitigate the risk of the disease spread northwards.

Warwickshire borders three other Edge Area counties of Leicestershire, Northamptonshire and Oxfordshire. The area which borders these counties is reasonably dense with cattle and cattle holdings, which might act as sentinels to detect the spread of wildlife infection. This could be the case for Northamptonshire and Oxfordshire. The Leicestershire border, although the most populated with cattle and cattle holdings, had a low herd incidence but Warwickshire does pose a risk to Leicestershire particularly given that its overall herd incidence is also lower than Warwickshire's.

Although Northamptonshire has a lower herd incidence and prevalence than Warwickshire, there is some evidence of TB endemicity along the border of both counties therefore at present they pose a similar risk to one other.

Assessment of effectiveness of controls and forward look

Despite the introduction of a routine six-monthly surveillance testing in 2018 and the expectation that the herd incidence rate would increase, a reduction in numbers of new incidents has been noted for the second consecutive year.

Enhanced cattle related measures (six-monthly routine testing, extending compulsory IFN-γ testing to the whole county, severe interpretation of at least the first two tests for all incidents) should improve the detection of TB infected cattle and reduce the lateral spread of TB. The decreasing number of incidents might be a result of these measures but further observation of trends is needed to state this with confidence.

Anecdotally, decreasing herd incidence and prevalence could also be attributed to better biosecurity awareness amongst the farming community. This is achieved through communications with APHA

case vets, the farmers' own veterinary providers, the implementation of the TB Advisory Service (TBAS, www.tbas.org.uk/), and access to the TB hub website (https://tbhub.co.uk/).

With the most common suspected source of TB infection being badgers, other measures are still required to address this source to prevent recurrence of new infection once testing and slaughter have removed diseased cattle. The potential for achieving OTF status for Warwickshire is compromised by the impact of the suspected level of endemicity in wildlife and the difficulties associated with controlling this risk factor.

Appendices

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

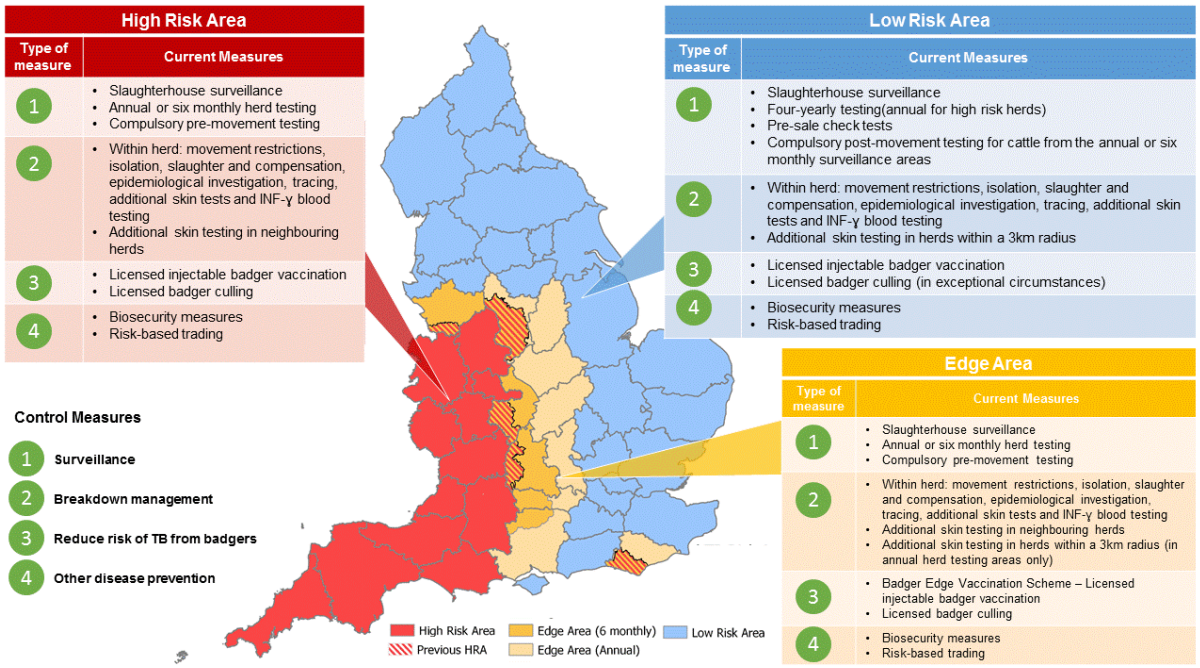

Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Bovine Tuberculosis Free status for England. Map based on information published on www.tbhub.co.uk.

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 Warwickshire

Edge Area testing policy

- Replacement of annual surveillance testing with six-monthly testing in 2018. From May 2019, earned recognition status in the form of annual testing applied to holdings with no TB incidents in the previous six years or herds registered to a bovine TB health scheme accredited under the Cattle Health Certification Standards (CHeCS) at level 1 or above.

Other testing measures

- Discretionary exemptions from routine testing of intensively fattened beef herds when all cattle are resident on the holding for no more than 12 months and the only movement off is to slaughter. No breeding must be taking place on the holding.
- Discretionary exemptions from mandatory IFN-γ testing of certain low risk groups of animals after the whole herd underwent the first round of testing. These are applied where there is a strong veterinary justification and where blood testing is likely to be an inefficient way of controlling the TB incident.
- The number of cases of overdue TB testing (skin and IFN-γ) is not significant and these are usually resolved before any formal enforcement tools are utilised. There is no evidence of those delayed tests having any notable impact on the epidemiology of TB in Warwickshire in 2019.

Other control measures

- Provision of free biosecurity advice by the TB Advisory Service (TBAS, www.tbas.org.uk/)
- Quality Control audits of Official Veterinarians (OV) performing TB testing carried out by APHA and Veterinary Delivery Partners who are contracted to provide the statutory TB skin testing on behalf of APHA.

Appendix 2: cattle industry in Warwickshire

Table A2.1: Number of cattle premises by size band in Warwickshire 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	245	102	100	49	16	16	531	110	58

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of Cattle	40,110 (68%)	15,770 (27%)	2445 (4%)	7 (<0.01%)	58,332

Appendix 3: summary of headline cattle TB statistics

Table A3.1: Herd-level summary statistics for TB in cattle in Warwickshire 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	647	625	628
(b) Total number of whole herd skin tests carried out at any time in the period	724	959	968
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	519	513	504
(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)	559	530	549
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	580	555	566
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	83	80	68
• OTF-S	24	27	27
• OTF-W	59	53	41
(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?	0 (Edge only)	3	8
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	5 (Edge only)	31	22
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.)	7 (Edge only)	16	14

Herd-level statistics	2017	2018	2019
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	9	5	5
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	n/a	n/a	n/a
• OTF-W	n/a	n/a	n/a
(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)	45	45	39
(j) New confirmed (positive *M. bovis* culture) incidents in non-bovine species detected during the report period (indicate host species involved)	0	0	0
(k) Number and type of finishing units active at end of the period:			
• Approved Finishing Units: Grazing	0	0	0
• Approved Finishing Units: Non Grazing	12	13	14
• Exempt Finishing Units: Grazing	0	0	0
• Exempt Finishing Units: Non Grazing	0	0	0

Table A3.2: Animal-level summary statistics for TB in cattle between 2017 and 2019.

Animal-level statistics (cattle)	2017	2018	2019
(a) Total number of cattle tested in the period (animal tests)	88,585	119,497	123,524
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	282	426	335
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	109	332	403
(c) Reactors detected during year per incidents disclosed during year *	4.7	9.5	10.9
(d) Reactors per 1000 animal tests	4.4	6.3	6.0
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	4	8	9
• Private slaughters	5	10	15
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	17	14	15
(g) SLH cases confirmed by culture of *M. bovis* **	13	8	8

* Note: reactors may be from incidents disclosed in earlier years, as any found through testing during the report year count here.
** Note: not all cases reported are submitted for culture analysis. All cases reported are from any period prior to or during restrictions.

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

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

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	21	20	21	1	50.3%
Cattle movements	18	1	9	1	17.6%
Contiguous	3	0	0	0	0.7%
Residual infection	6	4	0	0	3.8%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	2	0	0	0	0.5%
Other wildlife	17	8	2	0	11.1%
Other or unknown source	4	0	1	0	16.1%

Please note that each TB incident could have up to three potential pathways so totals may not equate to the number of actual incidents that have occurred. Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the Explanatory Supplement for 2019 (https://www.gov.uk/government/publications/bovine-tb-epidemiology-and-surveillance-in-great-britain-2019).

This publication is available at www.gov.uk/government/publications

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