Animal & Plant Health Agency

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

County: Warwickshire

Year-end report for: 2020

TB Edge Area - WARWICKSHIRE

TR398 (Rev. 03/21)

Contents

Executive summary

Reporting area

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

Local cattle industry

There was a continuing predominance of small herds of up to 50 cattle in the county. Beef cattle accounted for 70% of total cattle in 2020. There continued to be a number of approved finishing units, but no new approvals were granted in 2020.

New TB incidents

There was a total of 64 new TB incidents during 2020, 45 were OTF-W and 19 OTF-S. This represented a slight decrease on the total number detected in 2019 (69), although the number of OTF-W incidents rose to 45 from 43. This was the third consecutive year that there has been an overall decrease in the number of new incidents in this county. It is too early to say if this decline can be expected to continue.

There was a decline in both incidence and prevalence in 2020. Incidence declined from 16.7 incidents per 100 herd years at risk (100 HYR) in 2019 to 14.8 in 2020. Prevalence, a point measurement of how many herds are under restrictions at the end of the year, declined from 9.1% of herds under restriction in 2019 to 8.3% in 2020.

There were no known consequences of COVID-19 restrictions on testing or disease control.

Risk pathways for TB infection

As in previous years, the most common pathway for infection in OTF-W incidents in 2020 was direct or indirect contact with badgers (50%), with infected cattle movements accounting for 12%. Of the OTF-S incidents, 33% were attributed to cattle movements whereas badgers were the most likely source in 28% of those incidents.

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

Disclosing tests

As in previous years, routine (six- and occasionally twelve-monthly) skin testing disclosed the majority of incidents (38 out of 64). Post-incident six-month testing disclosed 11 out of 64. Surveillance in slaughterhouses (post-mortem meat inspection) remains an important method of disclosing disease, disclosing six OTF-W herds (9% of total) in 2020.

Reactor numbers

In 2020 526 bovines were removed for TB control purposes, a reduction of 29% on the 2019 figure of 738. Of these, 297 were skin test reactors and 229 were interferon gamma (IFN-γ) test reactors.

Risks to the reporting area

Warwickshire is under continuous risk of infection spread from the neighbouring High Risk Area (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 similar in terms of cattle density, herd incidence rate and source of infection identified.

Risks posed by the reporting area

Warwickshire is not contiguous to any of the Low Risk Area (LRA) counties and therefore does not pose a risk through local 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 third consecutive annual decrease in the number of TB incidents, 2020 still had a high number of incidents. The six-monthly routine surveillance testing of most cattle herds in Warwickshire supports the early detection of TB and reduces 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 2020. Bovine tuberculosis is caused by the organism *Mycobacterium bovis* (*M. bovis*) and will subsequently be referred to as TB.

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

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

In 2014 the UK 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. Control efforts are seeking to slow down and reverse geographic spread, and to reduce the incidence rate. The aim is to obtain OTF status for the Edge Area as soon as possible.

Changes to the Edge Area

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

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

Since May 2019, cattle herds in the six-monthly parts of the Edge Area that meet certain criteria are eligible to return to 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

Changes due to COVID-19

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

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

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

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

Cattle industry

Herd types

There is a predominance (51%) of small herds of up to 50 cattle in the county (Figure 1). Beef cattle accounted for 70% of total cattle in 2020, with dairy accounting for 25% (Appendix 2 Table A2.2). This is a similar profile to the 2019 herd makeup.

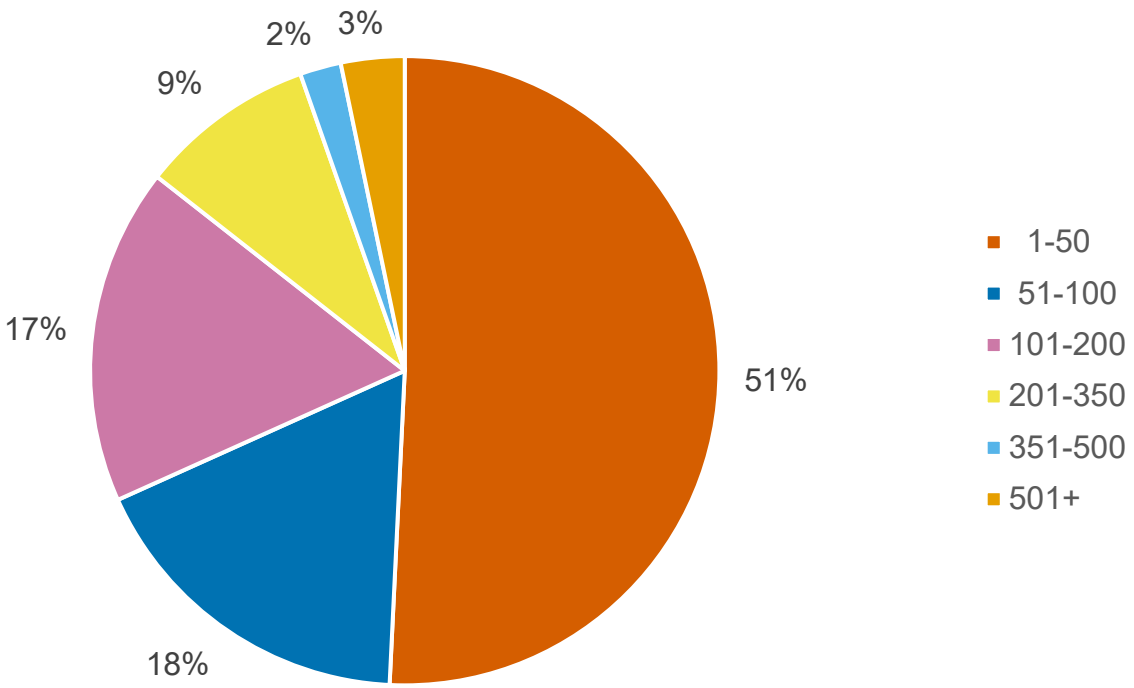


Figure 1: Proportion of cattle holdings in Warwickshire, by herd size in 2020 (n=520). Note herds with an undetermined size are not shown.

Markets and abattoirs

There is one livestock auction market in Warwickshire: Rugby Farmers Mart, located in Stoneleigh Park Agricultural Centre. The market is licensed by APHA to receive TB-restricted cattle (‘orange market’).

Warwickshire farmers may also use APHA-approved slaughter gatherings and dedicated sales for TB-restricted cattle in the neighbouring HRA counties of Worcestershire and Gloucestershire to sell negative-testing cattle from TB-restricted holdings.

There are two cattle abattoirs in Warwickshire.

Approved Finishing Units

Approved Finishing Units (AFUs) provide a route for beef producers to finish animals from both TB-restricted and unrestricted farms. It is an important trading route for restricted farms which are unable to finish their own cattle. Cattle from TB-restricted farms must have been tested for TB with negative results within 90 days before being moved to an AFU.

These units are approved by APHA and must follow strict conditions to reduce the potential risk of disease spread from the premises.

There were 12 AFUs in Warwickshire at the end 2020, with no new applications or approvals during 2020. Two AFUs had their licences suspended due to non-compliance. One of those was revoked and not reinstated. The other was reinstated after improvements were made.

Common land

There are 31 pieces of common land in Warwickshire that are registered with APHA. However, none of these were knowingly grazed by cattle during 2020. Grazing common land can be a high-risk strategy, especially in areas of high TB incidence, as cattle from multiple herds can mix freely.

Descriptive epidemiology of TB

Temporal TB trends

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

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

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

OTF-W incidents are those 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 (excluding Figure 5) in this report due to the limited epidemiological impact of these cases.

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

There continued to be a reduction in the total number of new TB incidents recorded in Warwickshire. In 2020 there was however a small increase in the number of OTF-W incidents to 45 from 43 in 2019 (Figure 2). There was a reduction in the number of OTF-S incidents in 2020 to 19 from 26 in 2019.

Caution in data interpretation should be applied when assessing a set 12-month period. A better reflection of the situation is to look at trends over a longer time period. Overall, the annual number of new incidents in Warwickshire has been declining since 2018 from the peak observed in 2017.

As in previous years, the reasons for this decline are varied. 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 higher incidence rate in subsequent years, 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 confirm this.

Following reclassification of the whole county of Warwickshire as Edge Area in January 2018, mandatory IFN-γ testing was applied to all the herds in the county sustaining new OTF-W incidents. Application of the IFN-γ test improves overall test sensitivity, reducing the risk of undetected (residual) cattle infection when the herd regains OTF status.

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.

Another factor contributing to the lower incident numbers could be improvements to on-farm biosecurity implemented by cattle owners. During 2020 the TB Advisory Service (TBAS) continued to offer cattle farmers free bespoke advice on biosecurity and building farm business resilience to TB.

Online resources such as ibTB and TB Hub were relaunched during 2020 and continued to be useful resources for farmers.

Figure 2 shows that over the last three years, the number of new incidents in the original Edge Area portion of Warwickshire has also been reducing. The original Edge Area has approximately two thirds of all the cattle herds in the county. The number of new incidents in 2020 was spread fairly evenly between the original Edge Area and former HRA portions. As a result, the original HRA section provides a disproportionate amount of disease pressure as it has only one third of the herds, but one half of incidents.

The TB herd incidence rate per 100 herd-years at risk (Figure 3) in the whole county of Warwickshire has fluctuated over the past 10 years. This measures the number of new incidents of disease that occur in a given time period in the population at risk. It also takes into account the historical testing frequency and the periods that a herd is classified as un-restricted and at risk of infection. Only herds that had a test during 2020 contributed to the measure. The numerator was the number of new TB incidents detected in 2020 in Warwickshire. The denominator was calculated by summing the time that all herds in the county were considered at risk of a TB incident.

There has been an overall rising plane of the incidence rate from 2010 to 2019, with annual fluctuations. There was a decline in 2020, but data from subsequent years is needed to see if this is a continuing decline.

Figure 4 shows that TB herd prevalence (the number of herds under restrictions divided by the number of total herds at the end of each year) continued to decline in Warwickshire. This is a point measurement.

It is difficult to quantify any impact that the COVID-19 pandemic may have had on testing during 2020. During national lockdown, the number of herds and cattle tested would have reduced, but by the end of 2020, this testing should have been completed. No herd was able to gain OTF status until the whole herd had passed the required number of supplementary tests.

In 2020, 118 fewer herds and 18,000 fewer animals were tested than in 2019, whether this represents a reduction due to COVID-19 or because of a genuine reduction in new incidents and need for testing remains to be seen in subsequent years.

Achieving OTF status in this county (crude incidence of indigenous OTF-W herd incidents less than 0.1%) is highly unlikely to happen within the next five years. However, all parties should continue to work hard to reduce the incidence and aim for OTF status.

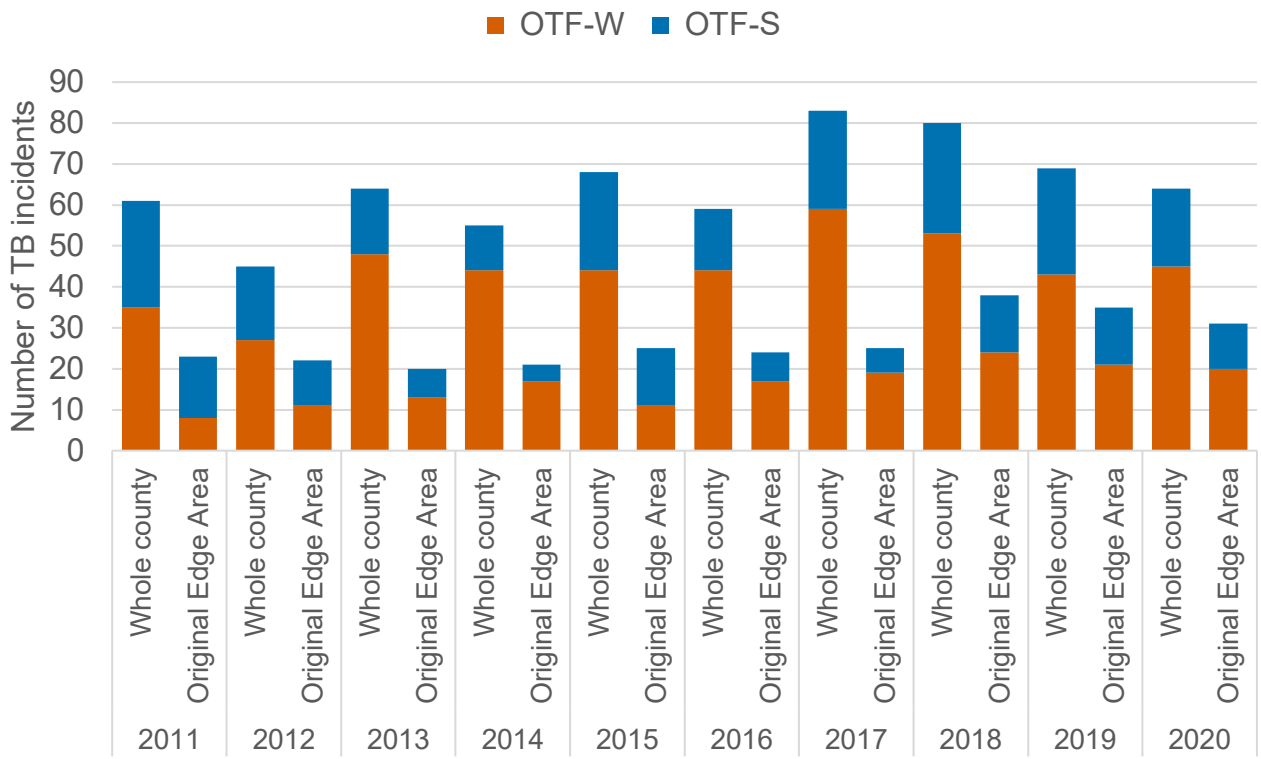


Figure 2: Annual number of new TB incidents in Warwickshire, from 2011 to 2020, showing incidents for the whole county and the original Edge Area.

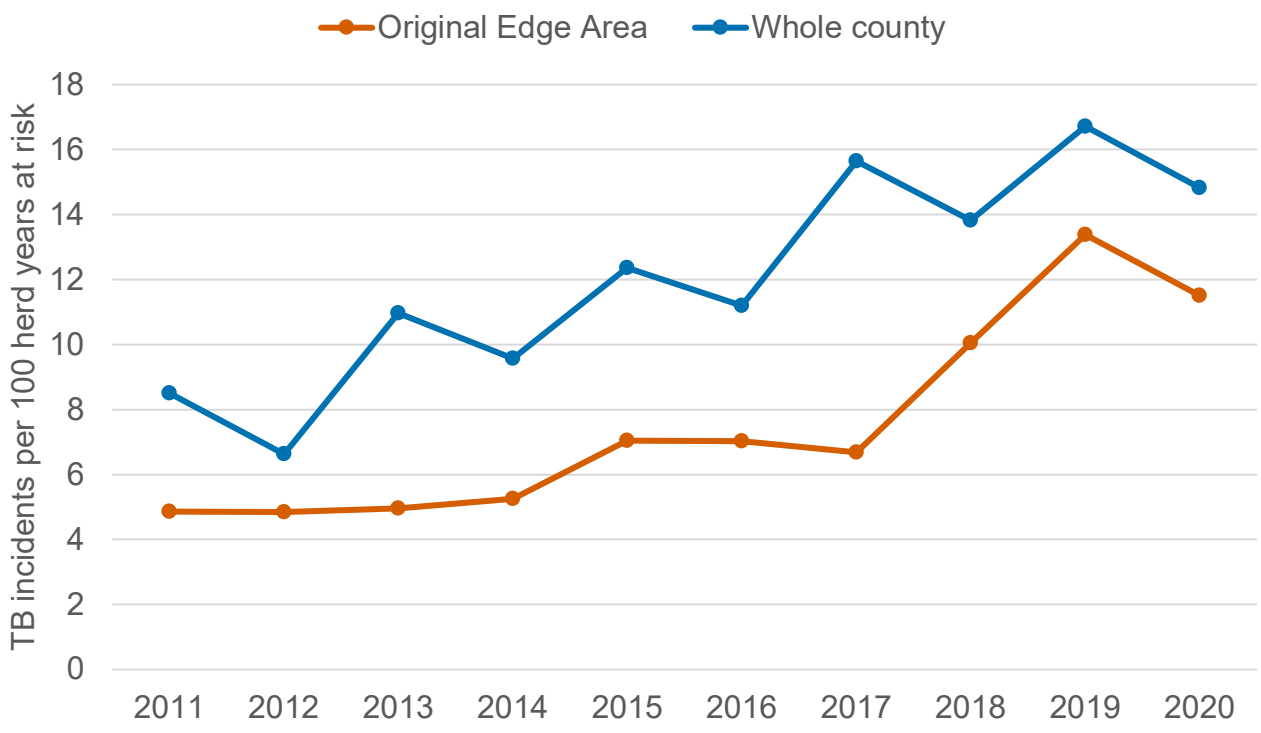


Figure 3: Annual incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in Warwickshire, from 2011 to 2020, showing incidents for the whole county and the original Edge Area.

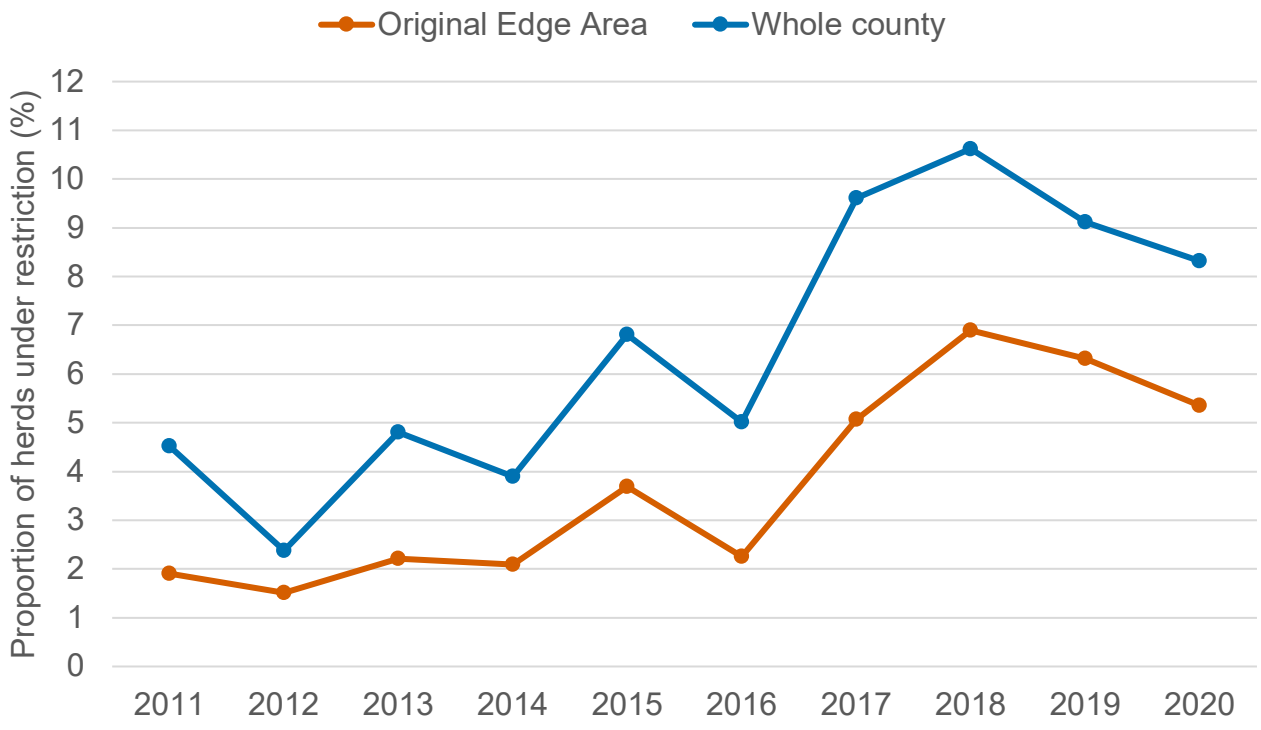


Figure 4: Annual end of year prevalence in Warwickshire, from 2011 to 2020, showing incidents for the whole county and the original Edge Area.

Geographical distribution of TB incidents

Warwickshire's incidence decreased in 2020 to 14.8 from 17.0 in 2019. However, one year's incidence cannot be assessed in isolation, thus it cannot yet be said that there is a true decline.

Although 2020's incidence was lower, it is concerning that Warwickshire has the second highest incidence of any county in the Edge Area (Figure 5).

Warwickshire is bordered by Worcestershire, Oxfordshire, Gloucestershire, and Staffordshire these present a risk to Warwickshire as they all have a higher incidence.

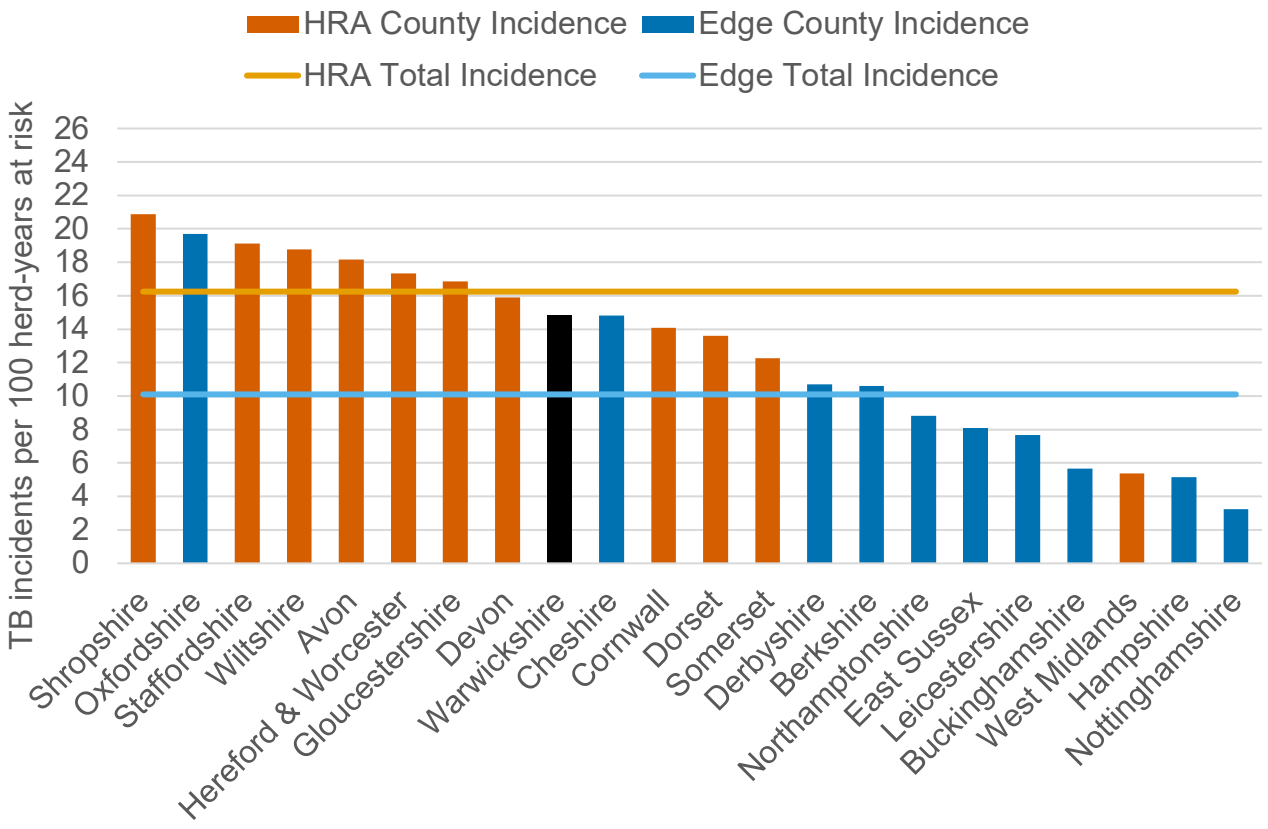


Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S including finishing units) in 2020, by HRA and Edge Area county, highlighting the county of Warwickshire.

The geographical distribution of new TB incidents in 2020 and pre-2020 OTF-W ongoing incidents with their associated spoligotypes is illustrated in Figure 6. Unlike in previous years there were less well defined clusters of incidents.

However, there was still a concentration of incidents along the Gloucestershire, Oxfordshire, and Northamptonshire borders.

Genotype 10:a continued to be the predominant strain of *M. bovis* isolated from cattle TB incidents in Warwickshire (Figures 6 and 7).

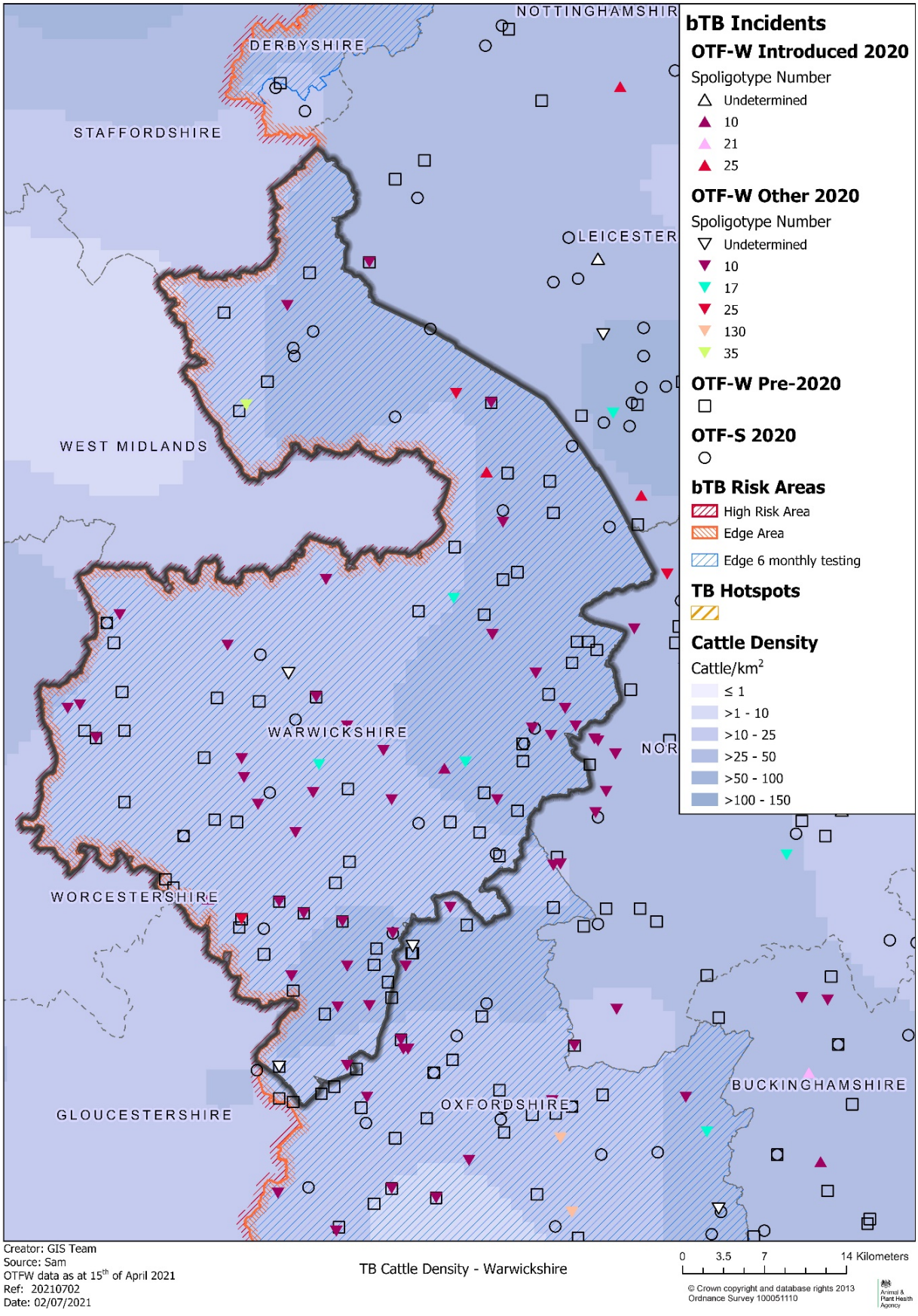


Figure 6: Location of cattle holdings in Warwickshire with new TB incidents (OTF-W and OTF-S) in 2020, and cattle holdings with pre-2020 OTF-W incidents still ongoing at the beginning of 2020, overlaid on a cattle density map. Note 'OTF-W Introduced 2020' refers to OTF-W incidents in which cattle movements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

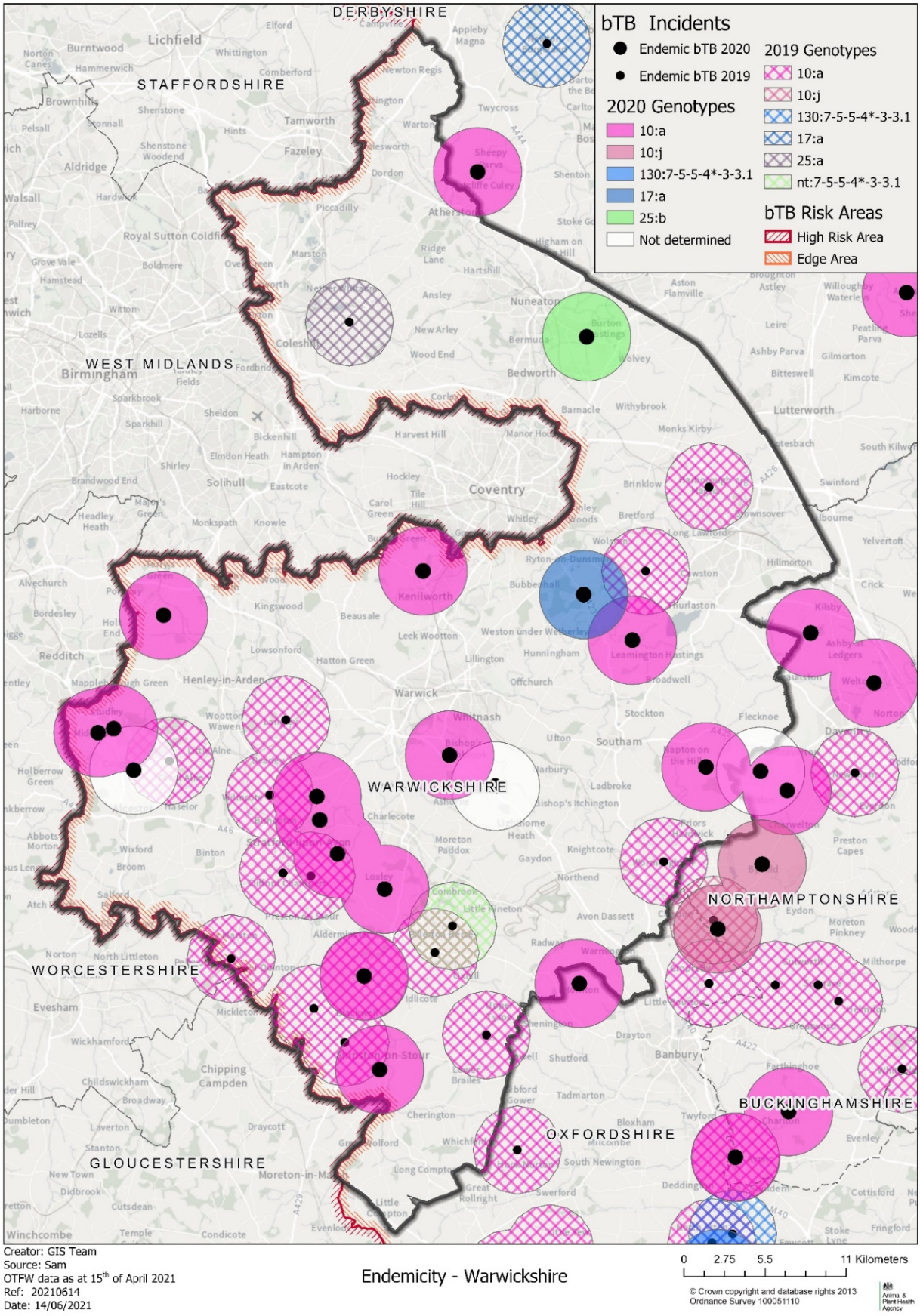


Figure 7: Genotypes of *M. bovis* detected in Warwickshire between 2019 and 2020, where wildlife sources were attributed with a 75% certainty or above according to the DRF calculation, as an indication of local *M. bovis* reservoir in wildlife populations (OTF-W incidents only).

Other characteristics of TB incidents

Incidents by herd type

Figure 8 shows the distribution of new TB incidents by herd type and size. Over half of the herds in Warwickshire had fewer than 50 animals (Figure 1), but these accounted for just 20% of the total incidents (13 out of 64).

Herds with 51 to 100 animals (18% of herds) accounted for 20% of total incidents (13 out of 64) and those with 101 to 200 (17% of herds) accounted for 31% of total incidents (20 out of 64).

Thus, it is the medium-sized herds (51 to 200) that represented 50% of the incidents, yet they accounted for only a third of the cattle in Warwickshire. This shows that herd size appears to have an impact on the risk of disease incursion, the larger the herd, the higher the risk, to a point.

In terms of herd type, beef farms (suckler and finisher combined) accounted for 73% of incidents and dairy 20%. This correlates well to the proportion of cattle kept under each system: 70% of cattle in Warwickshire are beef and 25% dairy. Thus, there is no apparent variance in risk of disease based on farm type.

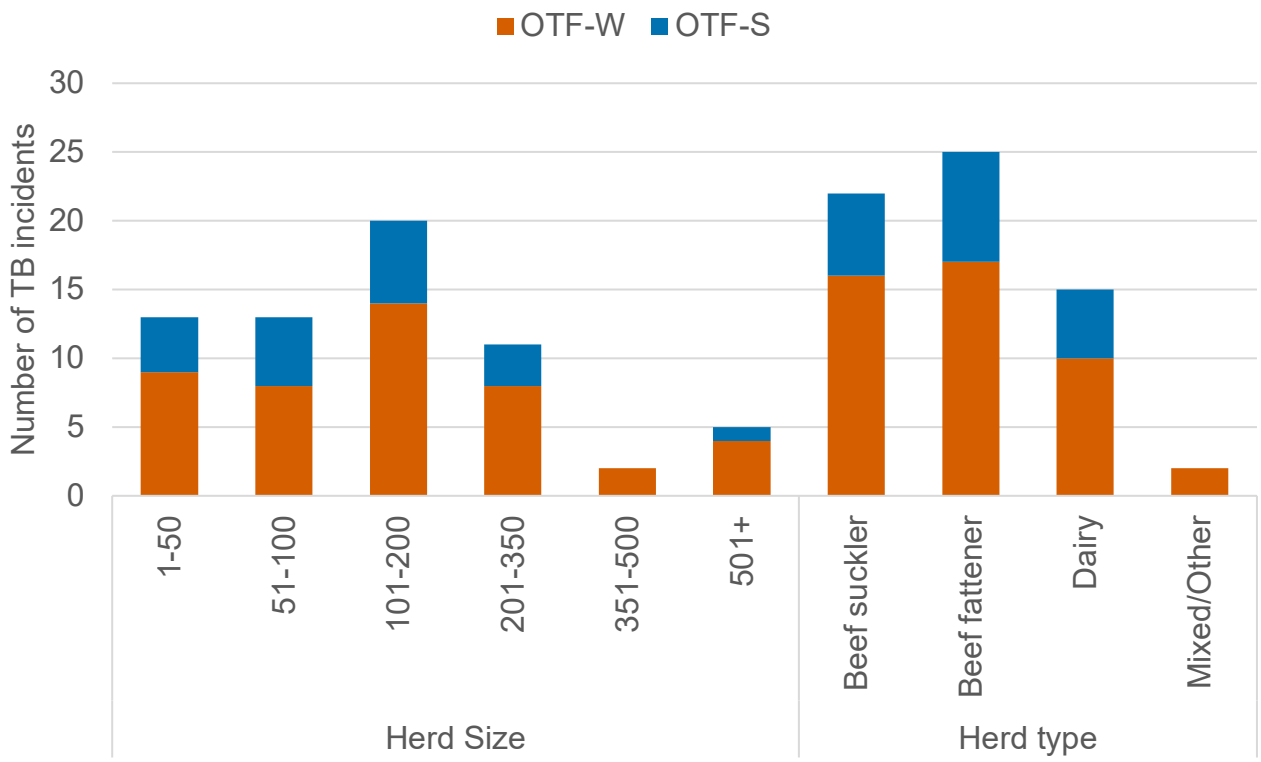


Figure 8: Number of TB incidents (OTF-W and OTF-S) in Warwickshire in 2020, by cattle herd size and type.

Incidents by month of disclosure

Traditionally, in six-monthly testing areas farmers prefer to test animals at housing (autumn) and turnout (spring). Thus, in previous years, there has been a notable spike in the number of incidents in October to November and March to April as this is when more testing happens.

Figure 9 shows that, unlike previous years, there was no spike in incidents in spring 2020, instead there was a steady increase from summer to autumn, with the majority of incidents detected in the second half of the year.

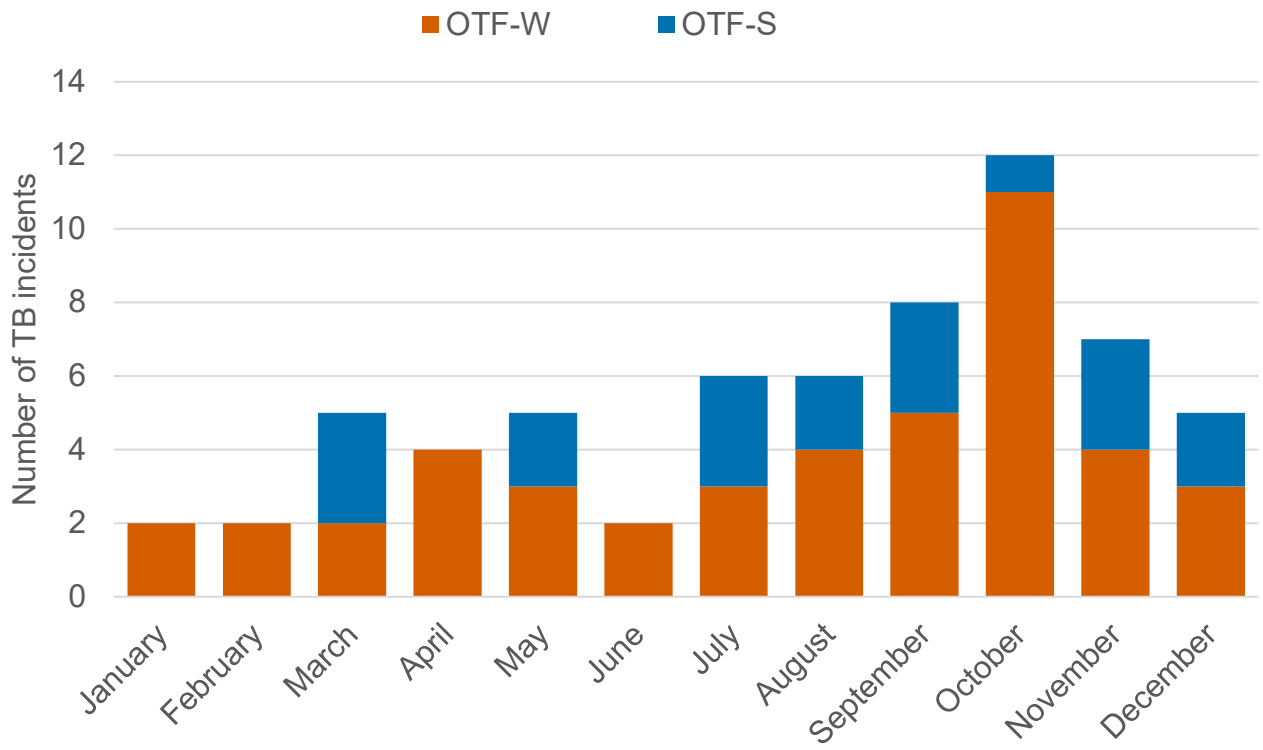


Figure 9: Number of TB incidents (OTF-W and OTF-S) in Warwickshire in 2020, by month of disclosure.

In March 2020, initial COVID-19 restrictions meant that there may have been a reduced amount of routine testing. The number of tests carried out in April was lower than March (Figure 10), and this may have had an impact on the number of incidents disclosed at this point.

However, there is no evidence that this temporary change in testing has had any impact on incidence. It is likely that the disclosure of incidents occurred later in the year than expected because testing was moved along a few months because of COVID-19 restrictions.

As in previous years, the autumn peak in detection could also be related to the fact that more cattle-badger interactions may take place in the summer during the grazing period.

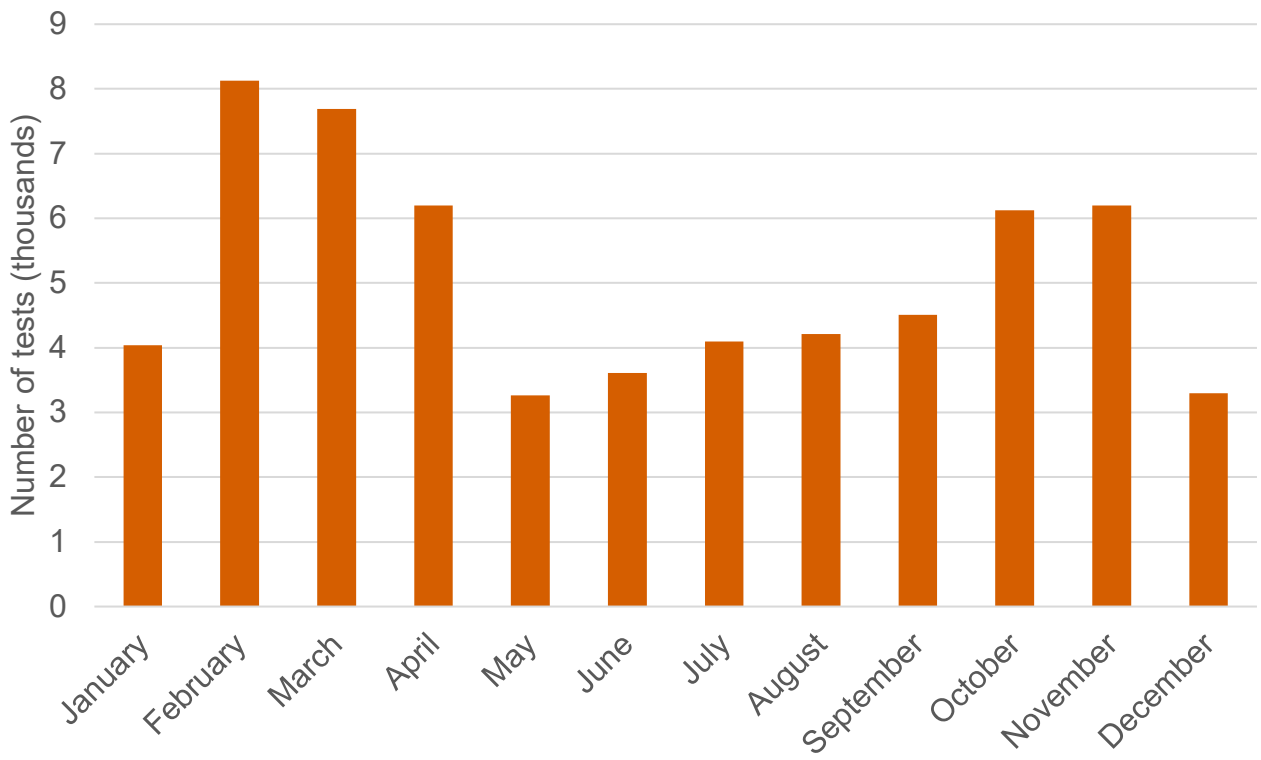


Figure 10: Number of tests undertaken in OTF herds in Warwickshire in 2020, by month.

Duration of incidents

Incident testing has an impact on the length of farm restrictions. In 2020, the minimum testing requirement for incidents in the Edge Area was two consecutive Short-Interval Tests (SITs) with negative results at the severe interpretation of the tuberculin skin test.

In 2020 the median duration of OTF-W incidents was 262 days, compared with 192 days for OTF-S incidents.

Figure 11 shows the distribution of incident durations for cases that concluded during 2020. There was no change in the pattern of incident duration compared with 2019. It is worth noting that some of these cases will have been disclosed in the previous years. Comparing the Edge Area as a whole, Warwickshire has the second longest average duration of incidents.

Herds in which movement restrictions exceed 551 days (18 months) are classed as persistent incidents.

In 2020, six OTF-W and one OTF-S persistent incidents were closed, and no persistent incidents remained open by the end of 2020 in Warwickshire (Figure 11). Of the seven persistent TB incidents that closed in 2020, two were noteworthy:

One OTF-S incident was persistent due to the farmer's reluctance to test. APHA had arranged for contractors to carry out an enforced TB test, but the farmer voluntarily presented the cattle for testing before this was required. This incident had lasted 40 months.

One OTF-W incident had lasted for 30 months, with 114 reactors removed from the affected herd.

The pathway was local infection (most likely wildlife). A case of this duration and magnitude puts significant financial pressure on both the farmer and taxpayer.

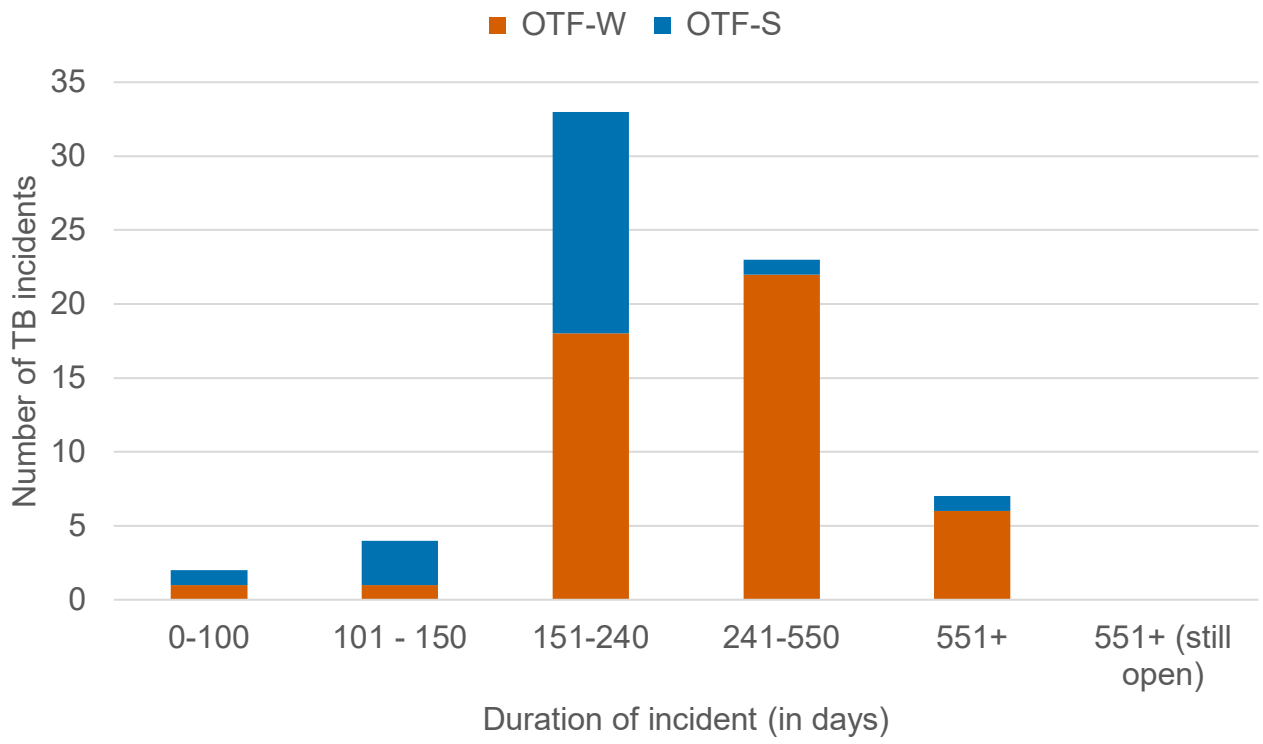


Figure 11: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2020, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2020 in Warwickshire. Note that Approved Finishing Units (AFUs) have been excluded.

Genotypes associated with TB incidents

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

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

Genotype 10:a continues to be the predominant type found in Warwickshire, being responsible for 77% of incidents in 2020. Further, all subtypes of 10 belong to the same WGS clade as they are closely related. Thus, 10:a, 10:h and 10:j can be grouped together, meaning that 81% of Warwickshire's OTF-W incidents can be attributed to genotype 10 or WGS clade B6-62.

Genotype 17 has a homerange on the Warwickshire-Northamptonshire border, but is predominantly found to the west of Warwickshire in the neighbouring HRA counties of Worcestershire and Herefordshire. Detection of genotype 17 could indicate local spread.

Genotype 25 is usually found in Derbyshire, Staffordshire, and Cheshire, and genotype 35 in Shropshire. Thus, these cases are most likely to be purchased.

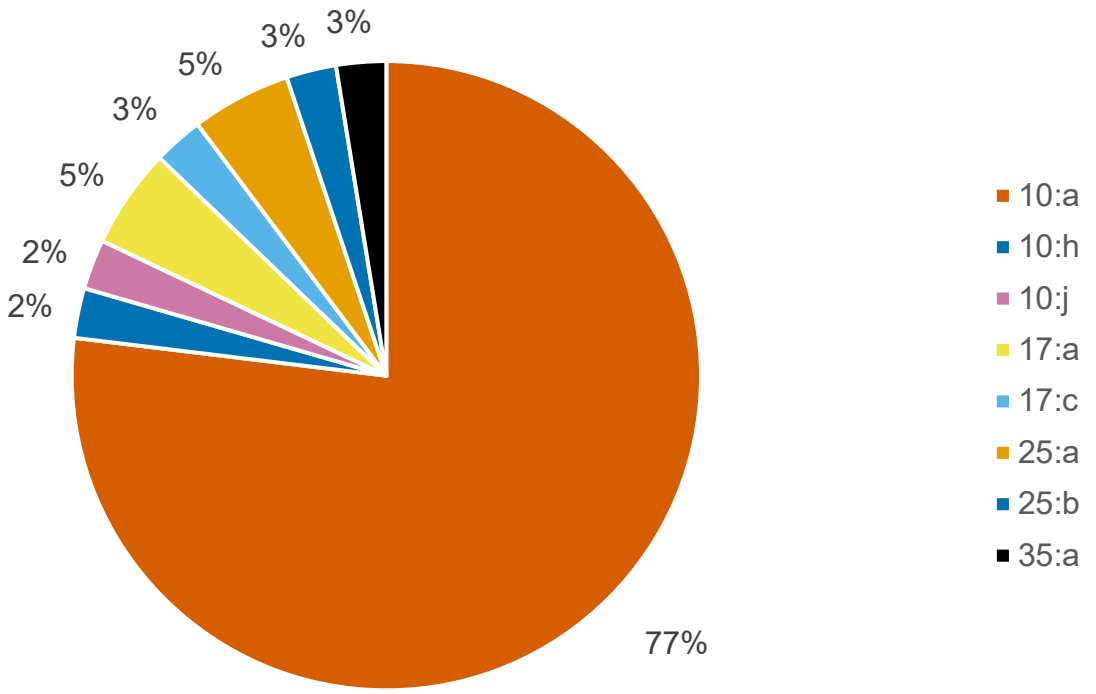


Figure 12: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Warwickshire in 2020 (n=39).

Unusual TB incidents

In addition to the persistent incidents discussed above, there were two other notable incidents:

- The keeper of a herd experiencing an OTF-W incident was feeding raw milk from TB reactor cows with udder lesions to the rearing calves. The calves subsequently became infected (24 out of 90 test reactor calves). This highlights the potential risks to animal and human health from unpasteurised milk from undetected TB-infected cows.
- A batch of 75 purchased calves was turned out at grazing in spring following a Whole Herd Test with negative results four months after arrival at the farm. At the next WHT in late summer, 25 out of 75 were disclosed as reactors. Decoupled IFN-γ disclosed 14 more reactors. This equated to 53% (39 out of 75) of the batch being removed with nearly a quarter (9 out of 39) of the reactors with lesions at PME. The disease pathway was confidently attributed to badger exposure at grazing, incident testing confirmed no infection among calves fully housed on the farm. Four of the seven

contiguous premises sustained TB incidents, including a water buffalo herd with the same genotype. This cluster of incidents was on the border with Northamptonshire.

Suspected sources, risk pathways and key drivers for TB infection

Key drivers of infection

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

- Endemic wildlife infection
- Cattle movements from infected areas and/or farms

Sources of infection and risk pathways

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

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

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

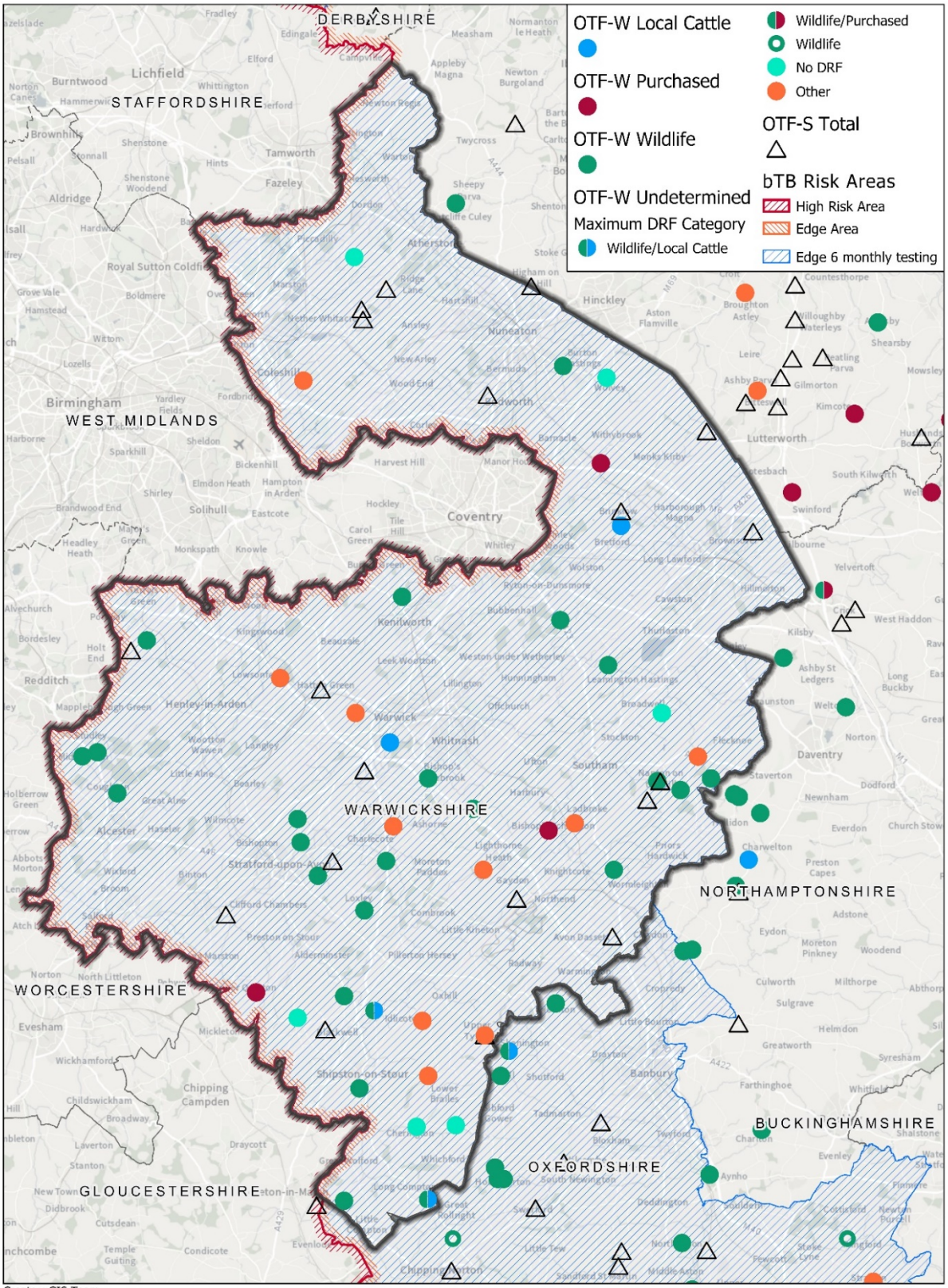
The score is recorded as either definite (score 8), most likely (score 6), likely (score 4) or possible (score 1). Risk pathway data are explored both at the herd and county level.

The most likely source of infection in individual TB incidents

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

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

As can be seen in Figure 13, wildlife and cattle movements continue to be the most likely cause of OTF-W incidents.


OTF-W Local Cattle
OTF-W Purchased
OTF-W Wildlife
OTF-W Undetermined
Maximum DRF Category
Wildlife/Local Cattle
Wildlife/Purchased
Wildlife
No DRF
Other
OTF-S Total
bTB Risk Areas
High Risk Area
Edge Area
Edge 6 monthly testing
DERBYSHIRE
STAFFORDSHIRE
WEST MIDLANDS
Birmingham
Coventry
WARWICKSHIRE
NORTHAMPTONSHIRE
WORCESTERSHIRE
GLOUCESTERSHIRE
OXFORDSHIRE
BUCKINGHAMSHIRE
Creator: GIS Team
Source: Sam
OTFW data as at 15th of April 2021
Ref: 20210604
Date: 04/06/2021
DRF Source - Warwickshire
0 2.75 5.5 11 Kilometers
© Crown copyright and database rights 2013
Ordnance Survey 100051110
Animal & Plant Health Agency

The weighted source of infection at county level

To consider the contribution of all sources of infection within an area, the source(s) for each incident are weighted by the certainty ascribed. Any combination of definite, most likely, likely, or possible sources can contribute towards the overall picture for possible routes of introduction into a herd.

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

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

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

As in previous years, the most common weighted pathway of infection in 2020 for new OTF-W incidents, was badgers (50%, Figure 14a). Cattle movements represented 13% of those risk pathways .

Together badger interaction and cattle movements made up almost two thirds of the weighted pathway for OTF-W incidents (63%). This is very similar to 2019, when the combined figure was 66%.

The most notable change for 2020 was the increase in the weighted risk pathways attributed to residual *M. bovis* infection from a previous incident in the same herd: 11% in 2020, up from 3% in 2019. The significance of this finding is not yet known.

For OTF-S incidents, a third of weighted risk pathways were attributed to cattle movements (Figure 14b). By their nature OTF-S incidents are more difficult to investigate as there is less information available to the investigating veterinarian. As a result, there may be less confidence in the most likely infection pathway for those incidents.

However, data such as cattle movements are available and so if the farm has a history of purchasing from high-risk herds, then there is a medium-high level of confidence in this pathway. Without further data such as genotype, it may be difficult to attribute a definitive risk pathway, hence the 24% of weighted risk pathways for OTF-S incidents that had an unknown source of infection.

In summary, at a county level, the major risk pathways were movements of undetected infected cattle and badgers.

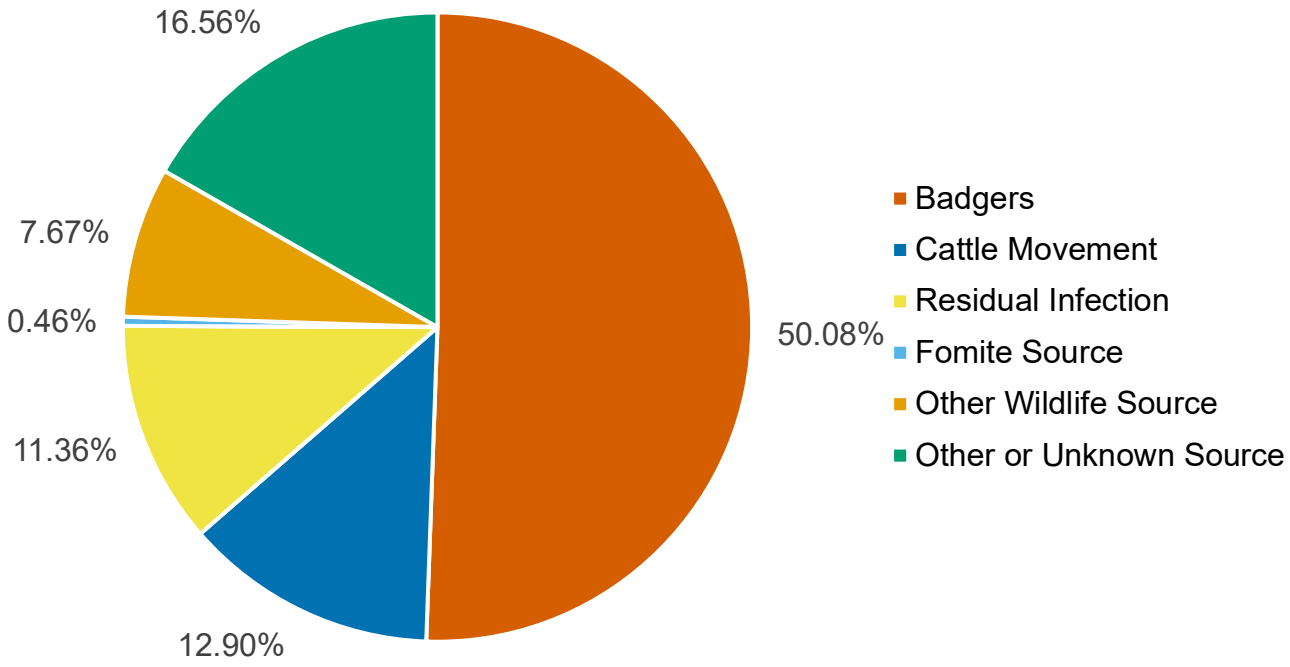


Figure 14a: Summary of the weighted source of infection pathways attributed for OTF-W TB incidents that started in 2020 in Warwickshire, that had a completed DRF (n=39).

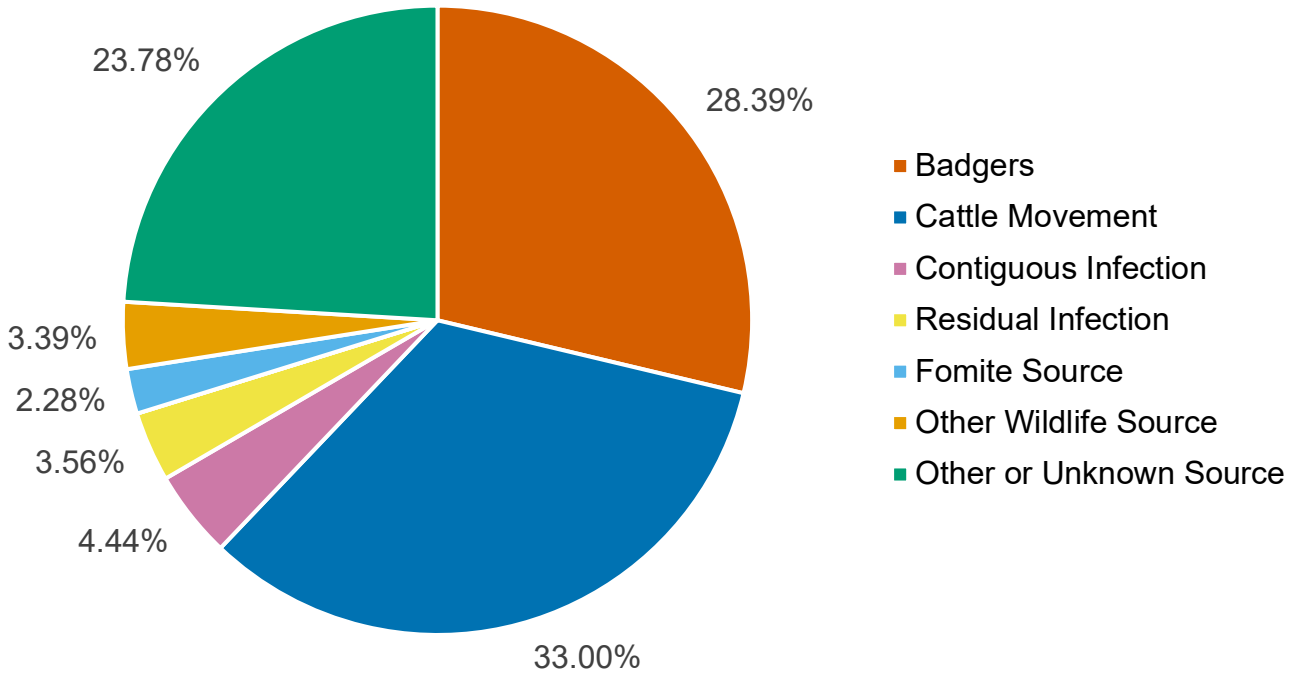


Figure 14b: Summary of the weighted source of infection pathways attributed for OTF-S TB incidents that started in 2020 in Warwickshire, that had a completed DRF (n=18).

TB in other species

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

Although badgers and, to a lesser degree deer, are a suspected source of many TB incidents in cattle, there was no laboratory confirmed isolation of *M. bovis* in 2020 in the county for these wild animals. Nor were there any TB incidents reported in domestic or farmed non-bovine species.

In 2020, an area of 1.3 km^2 was licenced for badger vaccination, but no badgers were vaccinated.

Detection of TB incidents

The majority of TB incidents (38 out of 64) were disclosed by routine whole herd surveillance testing (WHT) as shown in Figure 15. In 2018, the routine surveillance testing interval frequency of herds in Warwickshire and some other parts of the Edge Area changed from 12 to six months.

The importance of six-monthly testing cannot be underestimated in finding incidents quickly and minimising spread within and between herds.

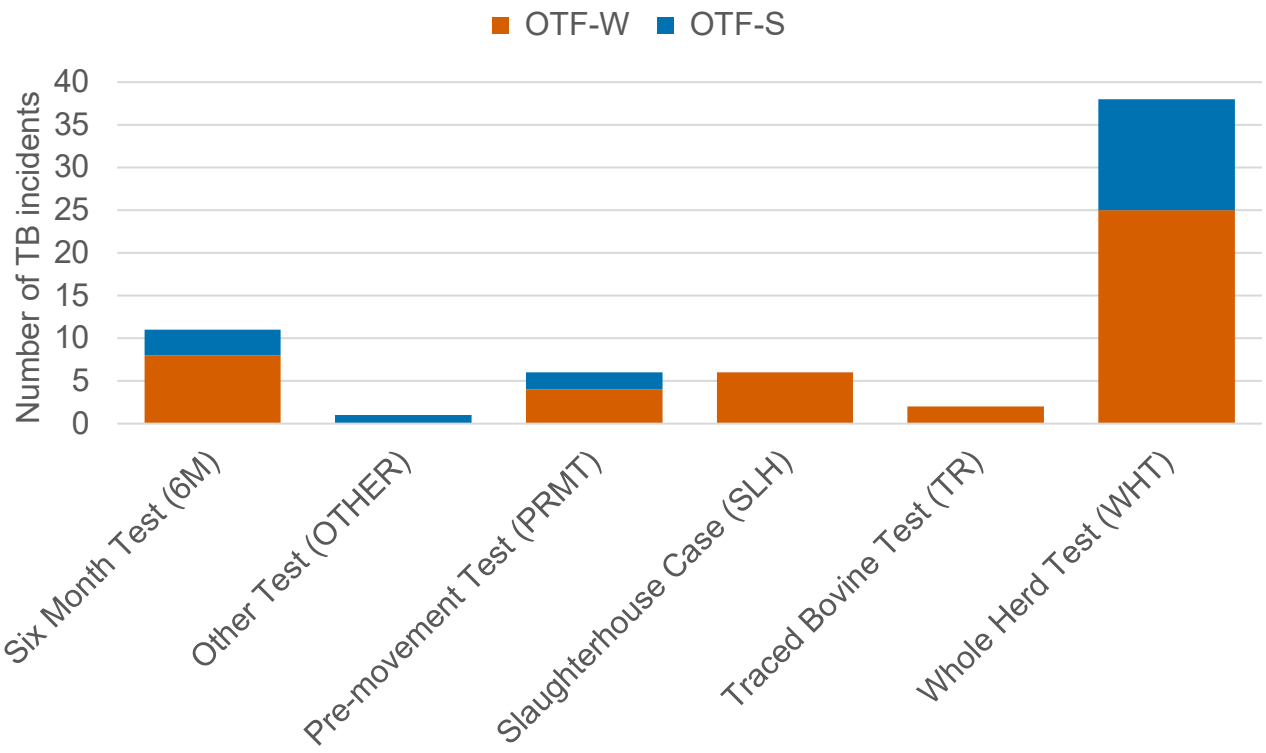


Figure 15: Number of TB incidents (OTF-W and OTF-S) in Warwickshire in 2020, disclosed by different surveillance methods.

The second most frequent type of test disclosing TB reactors was the six-month check test (6M) carried out six to eight months after conclusion of an incident. Eleven incidents in 2020 were disclosed at a 6M test: a reduction from the 2019 figure.

The reason for herds experiencing recurrent TB incidents at the 6M test is not only residual infection within a herd caused by a failure to detect every infected animal at the previous incident, 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 in cattle and wildlife. 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.

Routine post-mortem meat inspection of cattle from OTF holdings at slaughterhouses (SLH) disclosed six out of the 64 new incidents in 2020. TB surveillance in slaughterhouses (compared to on-farm TB surveillance by skin testing), continues to be a crucial supplementary method of detecting disease.

Some of the herds that had a slaughterhouse case may have a high throughput of animals that would not be on farm for the WHT. Therefore, post-mortem meat inspection ensures that these animals are inspected for suspected visible lesions of TB in their carcases and internal organs.

Pre-movement testing (PRMT) disclosed six incidents in 2020. PRMT helps reduce the risk of moving disease between farms and, simultaneously, supplements routine TB testing of herds.

Over half of incidents in 2020 (33) occurred in herds that had experienced another TB incident in the previous three years (Figure 16). These incidents will either be due to residual cattle infection or a new introduction of *M. bovis* in the herd.

The veterinary investigations noted the former as a possible source of infection for 15 of the 33 incidents, three of these noted it as ‘most likely’.

This suggests that although we are effective at clearing disease from infected herds, those herds become re-infected with a new source. This is despite increased testing, biosecurity, and advice on more careful purchasing of cattle.

Figure 16 shows the number of new OTF-W and OTF-S incidents in 2020, that had experienced an OTF-W incident in the previous three years. It excludes new incidents that were also on restrictions in the first four or more months of 2020 due to an incident that started before 2020.

The Explanatory Supplement (see section 4.3) provides more details on the reporting of recurrent TB incidents.

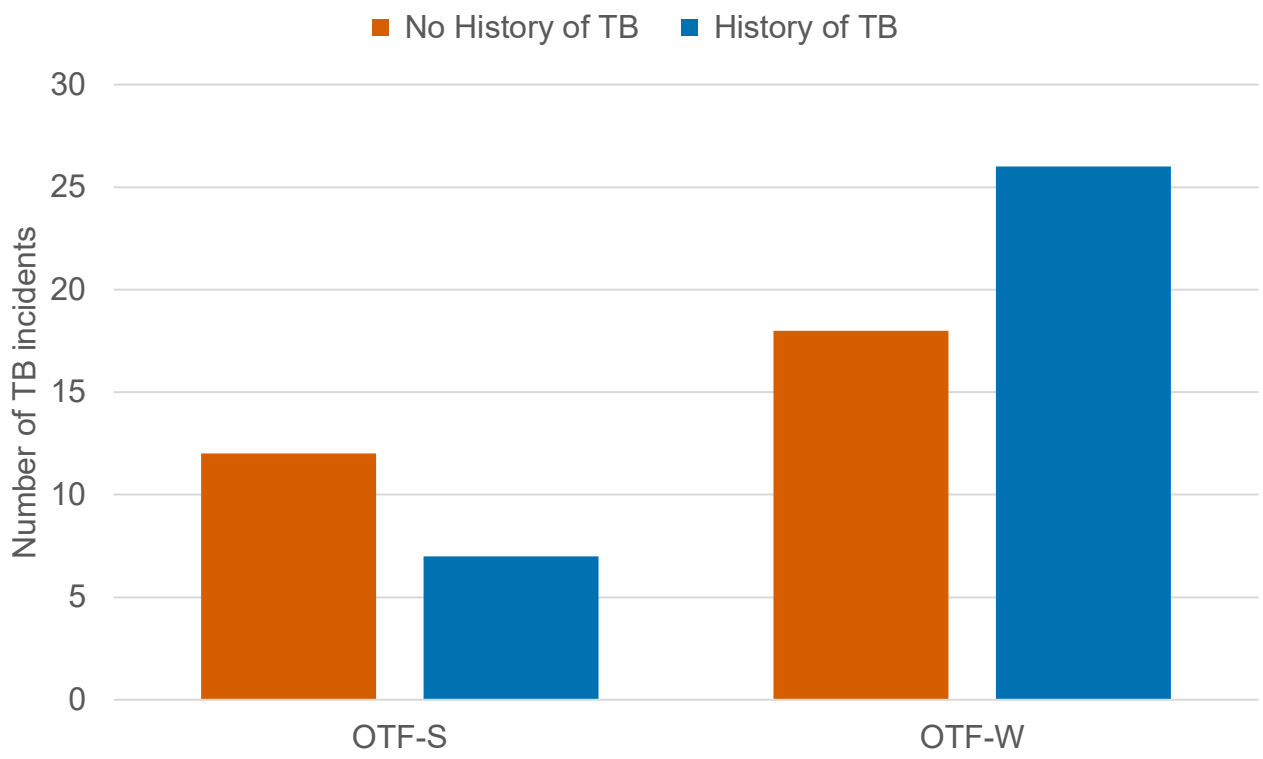


Figure 16: Number of herds with a TB incident (OTF-W and OTF-S) in Warwickshire in 2020, with a history of TB (herds that experienced an OTF-W incident in the previous three years), and holdings without a history of TB in the previous three years.

Skin test reactors and interferon gamma test positive animals removed

TB in cattle represents a significant 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 animals compulsorily removed by APHA for TB control purposes. Figure 17 shows the number of both skin test reactors and IFN-γ test positive animals annually removed in Warwickshire from 2011 to 2020.

The majority of cattle removed (56%) were skin reactors. The number of skin test reactors removed has stayed relatively constant since 2015 (excepting 2018, when the testing regime and risk area was changed).

The number of IFN-γ test reactors has decreased by a quarter in 2020 from 2019. This may be as a result of two consecutive years of six-monthly routine skin testing, which is disclosing incidents earlier, meaning spread within a herd is lower as infected cattle are detected and removed sooner.

There were no suspected cases of non-specific and fraudulent skin test reactors in 2020.

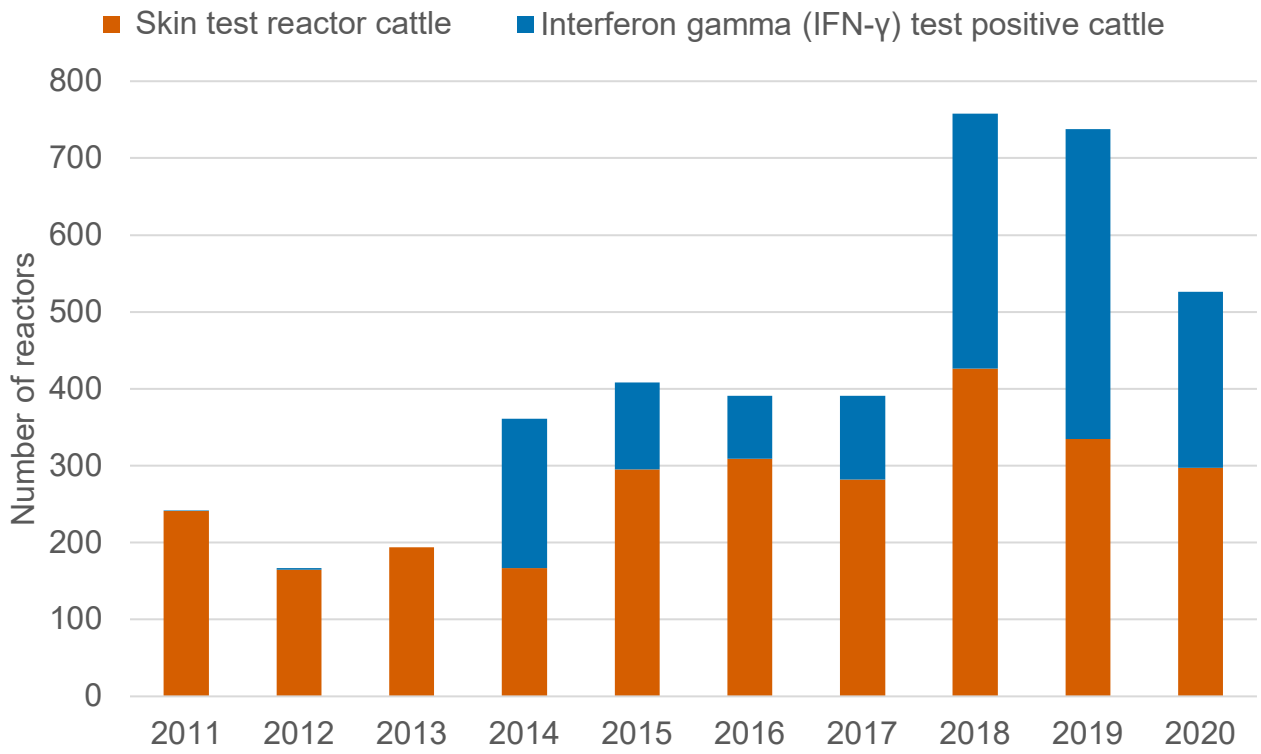


Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons in Warwickshire, 2011 to 2020.

Summary of risks to Warwickshire

Warwickshire is contiguous to the HRA along its western boundary, and so is at a constant risk of expansion of the endemic *M. bovis* infection front, 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.

Apart from the holdings at the borders of the county being exposed to the same wildlife reservoir as the neighbouring HRA holdings, movements of cattle from these HRA counties is common.

The 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. The establishment of more AFUs is encouraged.

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 it poses the highest TB risk to Warwickshire among its neighbouring Edge Area counties.

Summary of risks from Warwickshire to surrounding areas

Warwickshire is not contiguous to any of the LRA counties and so 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 Area towards the LRA.

The M40 and M6 motorways act, to some degree, as a physical barrier for wildlife movements and could mitigate the risk of the disease spreading 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 has a high density of cattle and cattle holdings. Warwickshire poses a risk to Leicestershire, particularly given that its overall herd incidence is also lower than Warwickshire.

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

Effectiveness of controls

Despite the introduction of 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 third 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 and test reactors taken 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 and improvements to the TB hub website.

With the most common suspected source of TB infection being badgers, other measures are still required to address this source to mitigate the risk of recurrence of new TB incidents once testing and slaughter have removed diseased cattle.

Forward look

If the number of incidents continue to fall, then the outlook is positive for Warwickshire. However, the potential for achieving OTF status for Warwickshire is compromised by the impact of the suspected level of endemicity in wildlife. There are difficulties associated with controlling this risk factor.

Appendices

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

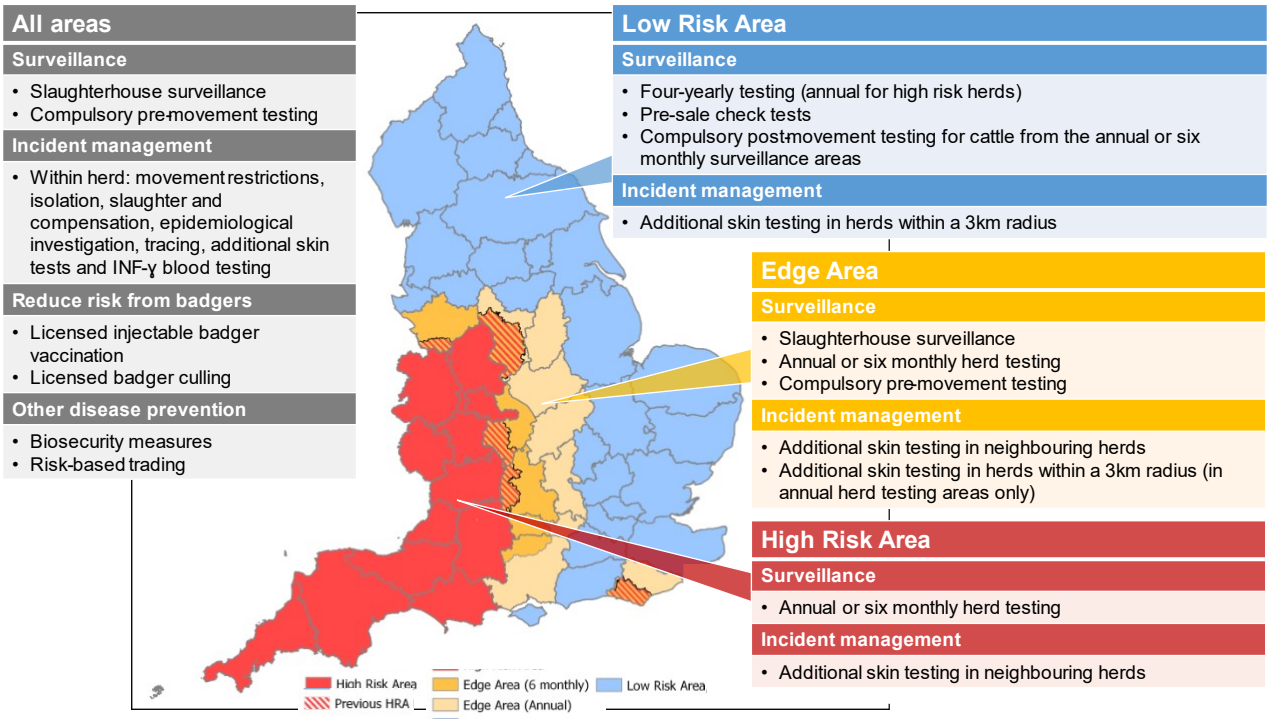


Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the UK government's Strategy for Achieving Officially Tuberculosis-Free Status for England. The map is described in more detail in the Explanatory Supplement for England 2020.

Short to medium term:

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

Longer term:

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

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

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

Key Control Measures

Surveillance:

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

Management of cases ('incidents'):

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

TB controls in the wildlife reservoir (badgers):

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

Other measures:

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

Summary of enhanced TB control measures in 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 has been 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 additional mandatory IFN-γ testing of certain low risk groups of animals after the whole OTF-W incident herd underwent a first round of blood testing. These partial exemptions are applied where there is a strong veterinary justification and where supplementary 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 2020.

Other control measures

- Provision of free biosecurity advice by the TB Advisory Service (TBAS)
- 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 2020. (RADAR data)

Size of herds	Un*	1-50	51-100	101-200	201-350	351-500	501+	Total number of herds	Mean herd size	Median herd size
Number of herds	4	264	91	90	47	11	17	524	103	49

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of cattle	38,256 (70%)	13,596 (25%)	2,290 (4%)	3 (less than 0.01%)	54,145

Appendix 3: Summary of headline cattle TB statistics

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

Herd-level statistics	2018	2019	2020
(a) Total number of cattle herds live on Sam at the end of the reporting period	625	628	626
(b) Total number of whole herd skin tests carried out at any time in the period	959	968	850
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	513	504	474
(d) Total number of OTF cattle herds at the end of the report period (herds not under any type of Notice Prohibiting the Movement of Bovine Animals (TB02) restrictions)	530	549	545
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	555	565	568
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	80	69	64
• OTF-S	27	26	19
• OTF-W	53	43	45
(g) Of the OTF-W herd incidents:			
• How many can be considered the result of movement, purchase or contact from or with an existing incident based on current evidence?	3	8	10

Herd-level statistics	2018	2019	2020
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	31	22	25
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (such as, forward and back-tracings, contiguous or check tests)	16	14	14
• New OTF-W incidents first detected through routine slaughterhouse TB surveillance	5	6	6
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds			
• OTF-S	0	0	0
• OTF-W	0	0	0
(i) Number of OTF-W herds still open at the end of the period (including any ongoing OTF-W incidents that began in a previous reporting period, but not including non-grazing Approved Finishing Units)	44	39	36
(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	13	14	12
• 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 in Warwickshire between 2018 and 2020.

Animal-level statistics (cattle)	2018	2019	2020
(a) Total number of cattle tested in the period (animal tests)	119,497	123,524	105,920
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	426	335	297
• Additional IFN-γ blood test reactors (skin-test negative or IR animals)	332	403	229
(c) Reactors detected during year per incidents disclosed during year	9.5	10.7	8.2
(d) Reactors per 1,000 animal tests	6.3	6.0	5.0
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	8	9	4
• Private slaughters	10	15	4
(f) SLH cases (tuberculous carcases) reported by Food Standards Agency (FSA)	14	15	13
(g) SLH cases confirmed by culture of *M. bovis*	8	8	11

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

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

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

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

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	20	14	23	0	43.6%
Cattle movements	14	4	7	2	19.4%
Contiguous	3	1	0	0	1.4%
Residual infection	7	5	3	0	9.0%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	5	0	0	0	1.1%
Other wildlife	20	2	0	0	6.5%
Other or unknown source	2	1	0	0	19.0%

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

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

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