



Animal &
Plant Health
Agency

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

County: Cheshire

Year-end report for: 2019

TB Edge Area - CHESHIRE



Contents

Executive summary	1
Reporting area	1
Local cattle industry	1
New incidents of TB	1
Suspected sources and risk pathways for TB infection	1
Disclosing tests	1
Reactor numbers:.....	1
Risks to the reporting area	2
Risks posed by the reporting area.....	2
Forward look	2
Introduction	3
Changes to the Edge Area in 2018.....	3
Cattle industry.....	4
Herd types.....	4
Markets	5
Approved Finishing Units	5
Common land.....	5
Descriptive epidemiology of TB	6
Temporal TB trends.....	6
Other characteristics of TB incidents.....	15
Suspected sources, risk pathways and key drivers for TB infection.....	18
TB in other species	22
Detection of incidents.....	23
Skin test reactors and interferon gamma test positive animals removed.....	25
Summary of risks to Cheshire.....	26

Summary of risks from Cheshire to surrounding areas	27
Assessment of effectiveness of controls and forward look.....	27
Appendices	28
Appendix 1: overview of risk and surveillance areas of England and Edge Area objectives and controls.....	28
Appendix 2: cattle industry in Cheshire	32
Appendix 3: summary of headline cattle TB statistics	33
Appendix 4: suspected sources of <i>M. bovis</i> infection for all of the new OTF-W and OTF- S incidents identified in the report period	36

Executive summary

Reporting area

Cheshire 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 Cheshire.

Local cattle industry

A predominantly dairy county, but with some beef fattener and suckler herds of varying sizes, calf rearers, smallholders and pet cattle.

New incidents of TB

The number of new incidents dropped by 6.1% from 179 in 2018 to 168 in 2019. In the original Edge Area portion of the county, the number of new incidents in 2019 remained at a similar level to 2018 (123), however a significant decrease has been identified in the portion of the county previously included in the High Risk Area (HRA), with 45 new incidents in 2019, 10 fewer than in 2018.

Suspected sources and risk pathways for TB infection

Infected badgers were the most likely attributed source (60.70% weighted source pathways) for TB incidents in 2019 followed by movements of undetected infected cattle (14.67% weighted source pathways), residual infection in cattle herds (9.04% weighted source pathways) and spread from contiguous cattle herds (2.41% weighted source pathways).

Details of the methodology used to calculate the weighted contribution of the different suspected sources of *M. bovis* infection for all new incidents can be found in the main body of the report and in the [Explanatory Supplement to the 2019 bovine TB epidemiology reports](#).

Disclosing tests

Routine herd surveillance testing continues to be the main method of disclosure of new TB incidents (55.9%) followed by six-month post-incident testing (23.2%) and passive slaughterhouse surveillance (12.5%) in 2019.

Reactor numbers: A total of 2,059 cattle were slaughtered due to a TB incident in 2019 as skin test reactors or interferon gamma (IFN- γ) test positives. Of these, 52.4% were IFN- γ test positive

and 47.5% were skin test reactors. There was a decrease compared to 2018 in the number of reactors, a return to the level of 2017. The 2018 increase on 2017 occurred due to the incorporation of the former HRA part of the county into the Edge Area and the subsequent application of six-monthly surveillance testing and mandatory IFN- γ testing of Officially TB Free Withdrawn (OTF-W) incident herds in the incorporated area.

Risks to the reporting area

The key risks to Cheshire are local spread via local cattle movement/contact and wildlife, and longer range cattle movement, especially from high risk areas of the country. There is an equivalent risk between Cheshire and Derbyshire (Edge Area), as well as persistent risks to and from north Staffordshire (HRA), north Shropshire (HRA) and north Wales, due to no substantial geographical barriers preventing cattle or wildlife movements.

Risks posed by the reporting area

The risk to the Low Risk Area (LRA) remains as in previous years along the northern border of Cheshire with Greater Manchester, in particular the Stockport area, and via cattle movements from Cheshire to the LRA. However, the impact of cattle movements has been lessened with the introduction of mandatory post-movement TB testing in the LRA in April 2016.

Forward look

Incorporation of the former HRA portion of the county into the Edge Area in January 2018 has resulted in an increased herd incidence in that area due to the increased surveillance TB testing frequency. It was likely that there was undisclosed infection in cattle herds in the absence of mandatory IFN- γ testing in herds in the HRA portion of the county prior to its incorporation into the Edge Area. However, there is evidence of infected wildlife in this area (<https://tbhub.co.uk/preventing-tb-breakdowns/about-bovine-tb/bovine-tb-research-and-development/badger-found-dead-survey-in-the-edge-area/>), so it is essential to enable relevant controls for both cattle and wildlife populations.

Recommended measures include:

- Continued use of six-monthly herd surveillance testing across the county
- Continued mandatory use of IFN- γ testing in new OTF-W incidents, and additional discretionary use in OTF-S incidents
- Encourage implementation of improved on-farm biosecurity measures, use of the TB Advisory Service (TBAS, www.tbas.org.uk/) and dissemination of knowledge using available resources such as the TB Hub (www.tbhub.co.uk) and ibTB websites (www.ibtb.co.uk)

Introduction

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

Cheshire was a split HRA/Edge Area county until the beginning of 2018. Prior to that, the majority of the county comprised the Edge Area with a relatively small portion of Cheshire, south of Nantwich, classed as HRA. Since 2015, six monthly herd surveillance testing was undertaken in the original Edge Area part of the county. In January 2018 annual routine herd surveillance testing was replaced by six monthly herd surveillance testing in the whole county of Cheshire. However from 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.

Cattle industry

Herd types

Dairy herds are the predominant herd type in Cheshire, with 68% of all cattle being dairy-sired (see Appendix 2). The county also has numerous beef enterprises – suckler herds, calf rearers and fattening units as well as some smallholders. Many dairy herds breed their own replacement cows, but some are partly or entirely ‘flying’ herds, where replacement cows or heifers are purchased from other farms.

As shown in Figure 1, there are 515 herds (39%) of 50 cattle or fewer, which represent hobby farmers as well as small scale beef herds, calf rearing units and pedigree herds. A total of 32% of herds have over 200 cattle, which may include many dairy units and a few beef units in Cheshire.

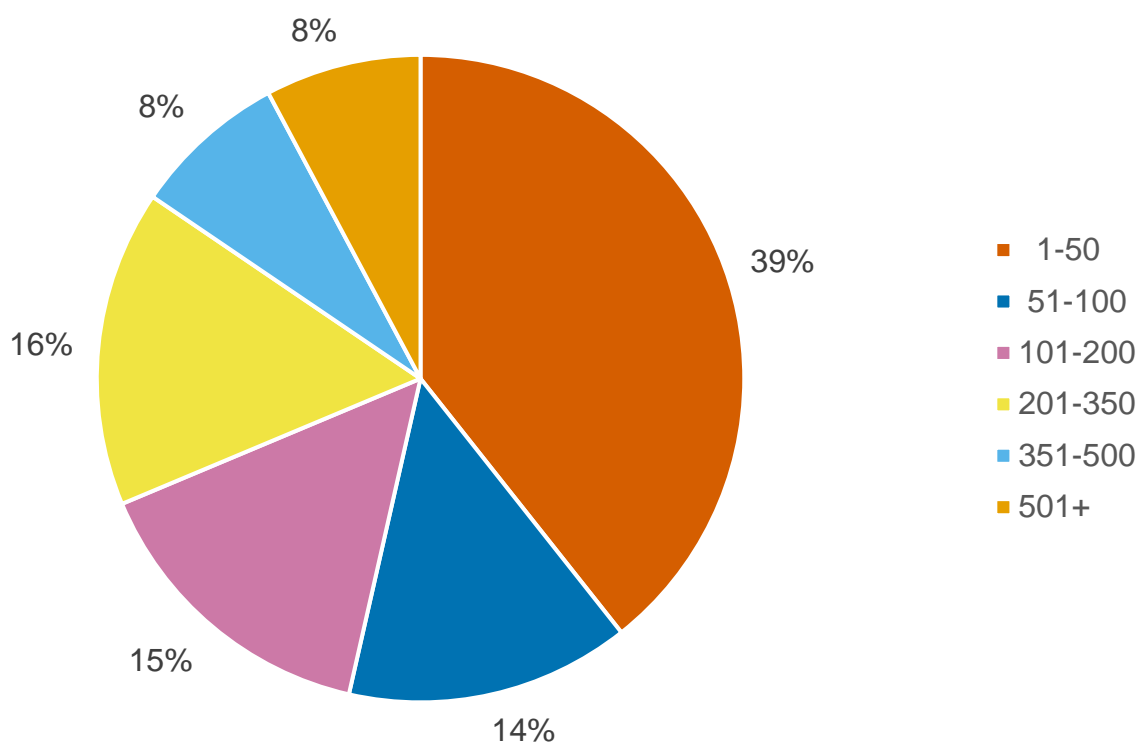


Figure 1: Proportion of cattle holdings by herd size in Cheshire in 2019 (n=1309).

Although there are still many smaller traditional family farms in the county, there has been a gradual trend for dairy herds to increase in size. There are 102 herds (8%) in Cheshire keeping more than 500 cattle and a large proportion of these are dairy units, some with over 1000 milking cows. There are a number of dairy farms which do not graze some or all of their cattle all year round. Cows on these farms may be ‘zero grazed’ for some of the year, where fresh grass is cut daily and fed to the cattle indoors, or they may be fed a grass silage based diet all year round. At the other end of the

spectrum there are also many herds on the 'New Zealand' style grazing system keeping cattle outdoors for as much of the year as possible, using small paddocks to keep grazing tight, and maximise yields from the grassland.

Some of the very large herds present their own challenges to TB management as they generally operate over multiple premises under the same ownership. There are also many smaller and medium sized dairy farms following a more traditional management system utilising pasture grazing in the summer and feeding conserved forage in winter. Each of the system types differ in their risk factors for TB infection, with the more intensive units vulnerable to contamination of stored feedstuffs by wildlife, and the increased potential for horizontal spread of cattle infection in housed animals in close proximity.

Markets

There was only one livestock market operational in Cheshire in 2019, located at Beeston Castle Auction near Tarporley. There was one regular sale day for all types of cattle, which includes herd dispersals, stores, beef, cull cows and calf sales. The market also offered farm-to-farm sales and on-farm herd dispersals. However, Beeston Castle Auction ceased operation on the 6th June 2019 leaving Cheshire with no livestock market in the county.

Approved Finishing Units

Two additional Approved Finishing Units (AFUs) for TB-restricted cattle were approved in Cheshire in 2019 giving a total of 29 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.

Six pre-movement testing Exempt Finishing Units (EFUs) were operational in Cheshire in 2019, a reduction of one from 2018. Two of these units are grazing and four units are non-grazing.

Common land

There are no areas of common grazing for cattle in Cheshire.

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 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 in this report due to the limited epidemiological impact of these cases. Furthermore, herds restricted because of an overdue test rather than a TB incident are also excluded from calculations. Measures of incidence and prevalence in this report may be lower than those reported in the official TB statistics.

As shown in Figure 2, overall, there appears to be a slight change in the number of new incidents, with a 6.1% reduction from 179 (2018) to 168 (2019). Separation of the county into the original Edge Area and HRA portions shows a different situation. In 2019 there were 123 new incidents disclosed in the original Cheshire Edge Area compared to 124 in 2018 giving an impression of a plateau effect. However, in the former HRA there were 45 new incidents disclosed in 2019 compared to 55 in 2018, representing a decrease of 18%. This can be partly explained by the increased surveillance testing frequency introduced to that part of the county in 2018, as part of its inclusion in the Edge Area, which led to earlier detection of TB in herds during that year.

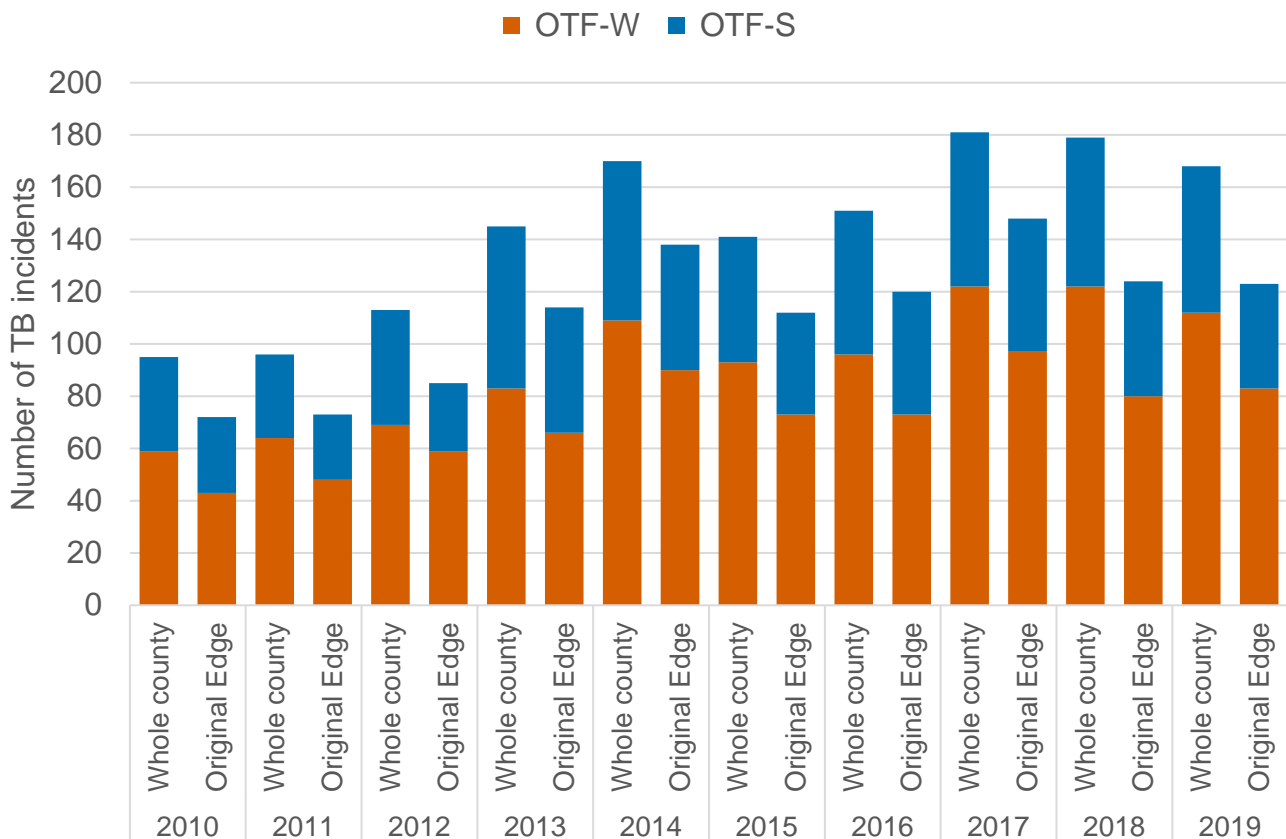


Figure 2: Annual number of new TB incidents in Cheshire, 2010 to 2019, showing incidents for the whole county and the original Edge Area.

The annual herd incidence rate (incidents per 100 herd-years at risk) in the whole county has maintained its ten year upward trajectory, after a two year plateau of approximately 14 in 2017 and 2018, to 17.1 in 2019 (Figure 3). As described earlier, the recent implementation in 2019 of earned recognition (lower risk herds subject to annual surveillance testing) is likely to have had an impact upon this figure, due to some herds being on annual testing as opposed to six-monthly testing which affects the denominator for this incidence rate measure (herd-years at risk). 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>). In contrast, the number of incidents per 100 unrestricted herds in the whole county, after following a similar ten year upward trajectory and a two year plateau in 2017 and 2018 of approximately 13, dropped slightly to 12.6 in 2019.

The annual incidence per 100 unrestricted herds in the original Edge Area alone (Figure 3) has increased slightly from 10.9 in 2018 to 11.3 in 2019. This shows that the overall county reduction in incidence per 100 unrestricted herds in 2019 has been driven by a reduction in herd incidence in the former HRA portion. The increased frequency of surveillance testing implemented in the former HRA portion of the county from 2018 appears to have resulted in an increased incidence per 100 unrestricted herds in that area in 2018. However, this has not been maintained in 2019 suggesting that earlier detection and removal of infected cattle in conjunction with more sensitive testing of OTF-

W herds may have resulted in reduced spread and less residual infection in herds, although there could be other factors to consider.

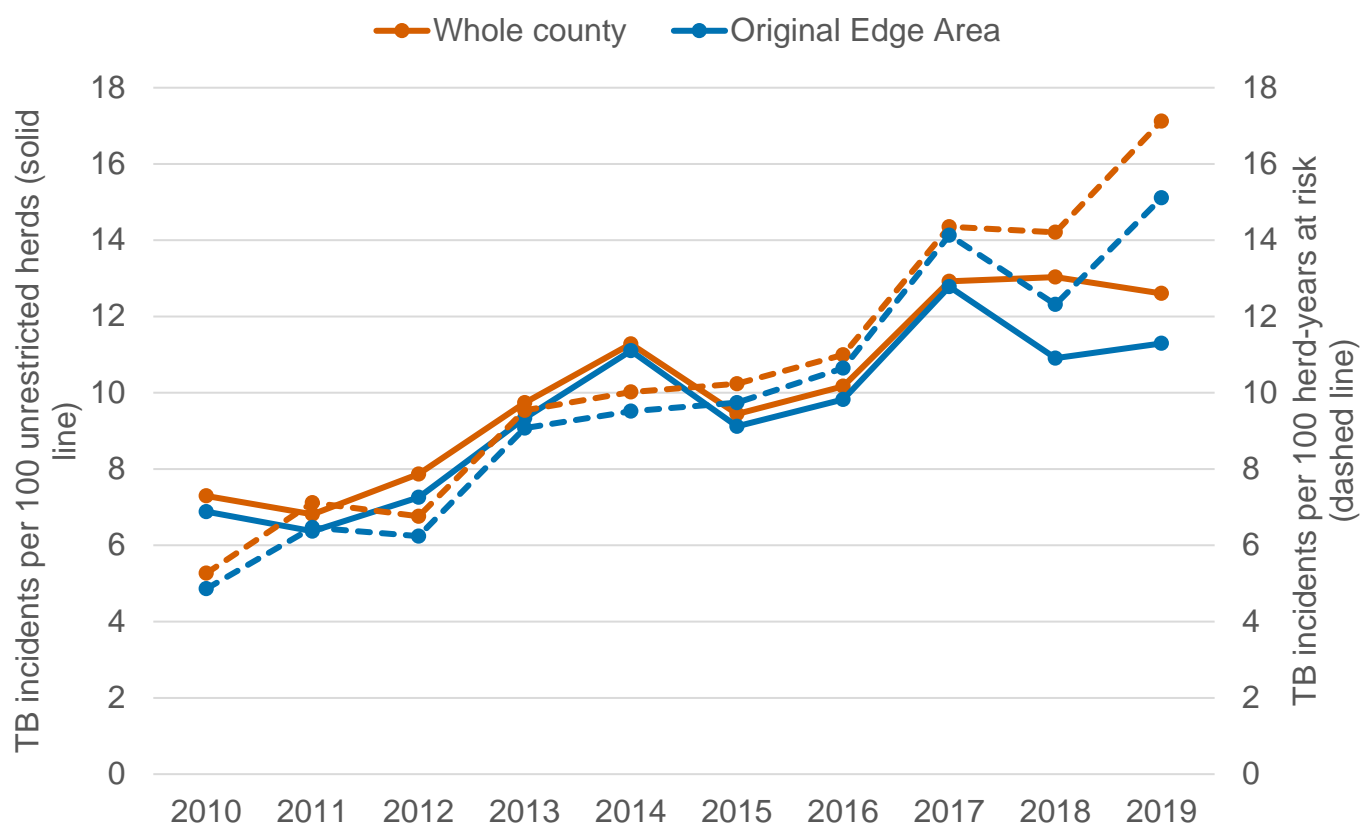


Figure 3: Annual herd incidence rate (per 100 herd-years at risk and per 100 unrestricted herds) for all new incidents (OTF-W and OTF-S) in Cheshire, 2010 to 2019, showing data for the whole county and for the original Edge Area.

Figure 4 takes into account new and existing TB incidents at a point in time (end of 2019) and this shows a decrease from 2018. At the end of 2019, 7.54% of all cattle herds in Cheshire were subject to movement restrictions because of a TB incident (a reduction from 8.34% in 2018). However, comparison of the original Edge Area portion with the whole county of Cheshire illustrates that the herd prevalence in the original Edge Area portion of Cheshire was lower at 6.99% (2018) and 7.22% (2019). This shows that the former HRA has a higher herd prevalence, resulting in a slower overall reduction in prevalence in the county.

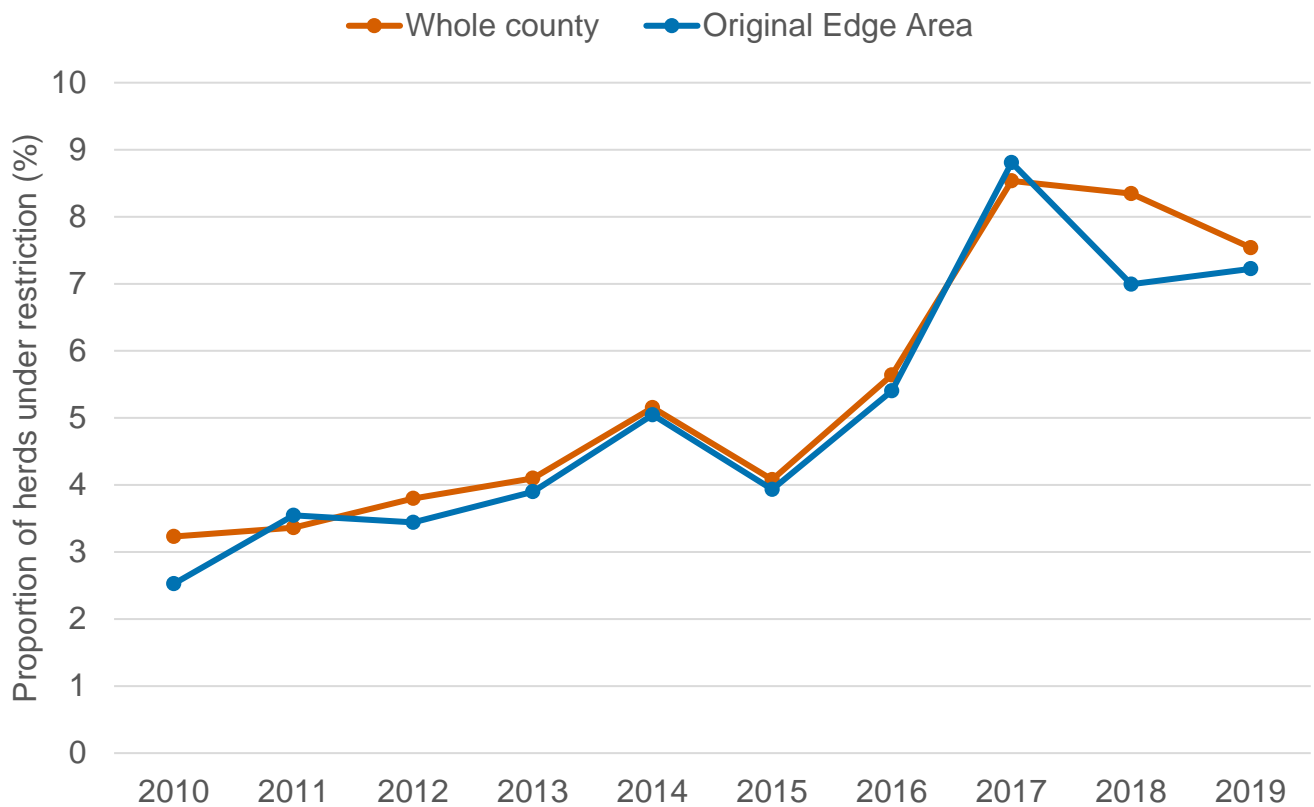


Figure 4: Annual end of year TB herd prevalence in Cheshire, 2010-2019, showing data for the whole county and for the original Edge Area.

Geographical distribution of TB incidents

The incidence in Cheshire (17.3) is slightly above the average incidence for the HRA (16.9), whereas the average incidence for the Edge Area is 9.9 (Figure 5). The only Edge Area county higher than Cheshire is Oxfordshire at 23.8.

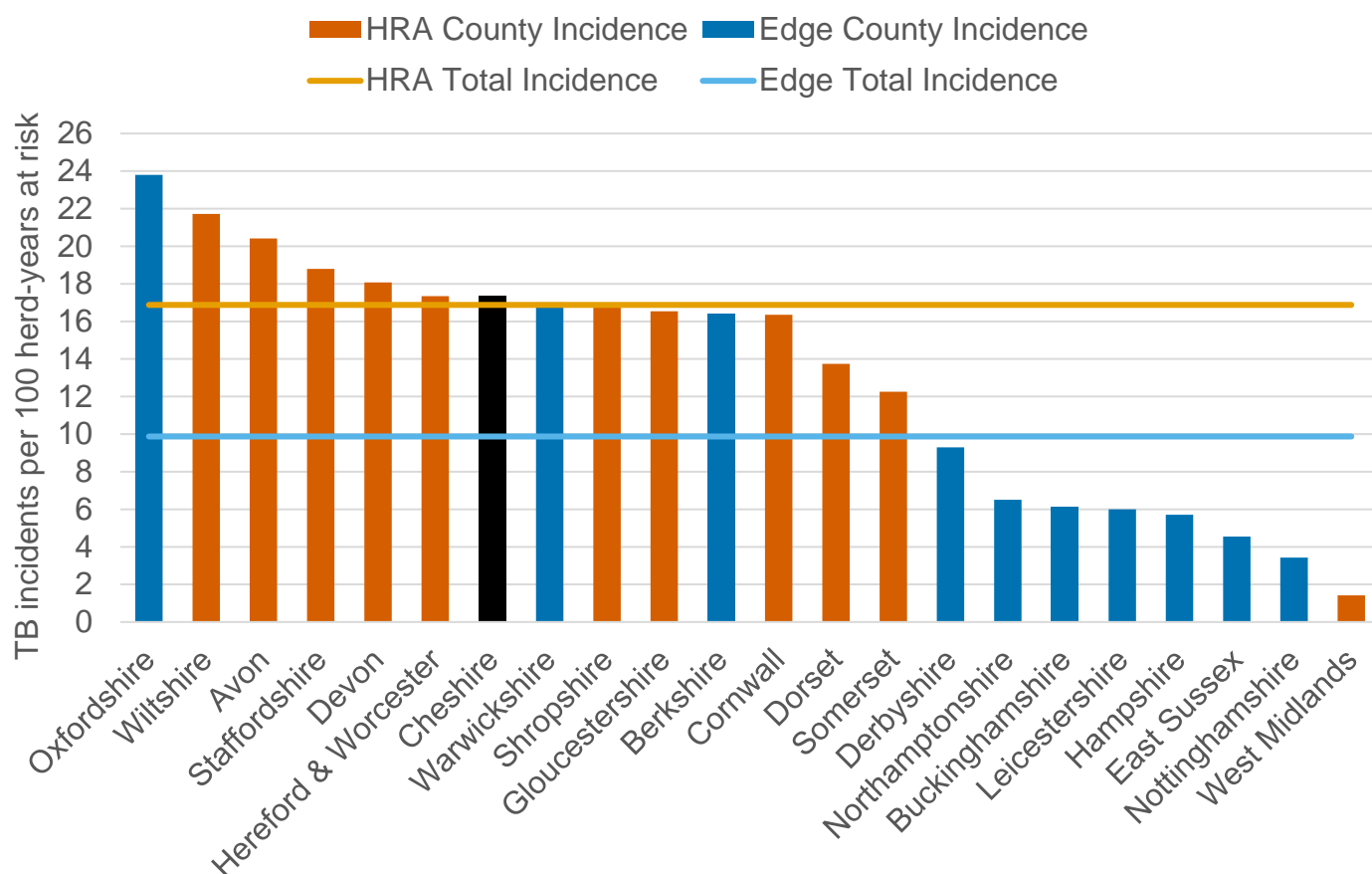


Figure 5: Incidence rate (per 100 herd-years at risk) for all new incidents (OTF-W and OTF-S) in 2019, by HRA and Edge Area County.

The distribution of new incidents in 2019 is concentrated mainly in the south and east of the county as in previous years, mirroring the highest density of cattle (Figure 6). In eastern Cheshire mostly OTF-W incidents with genotype 25:a were disclosed, with a smaller number of OTF-S and pre-2019 incidents interspersed. The mid-north area (and a small area in the south east) appears to have the greatest concentration of incidents ongoing from previous years.

The use of Whole Genome Sequencing (WGS) is a recent development in APHA and will aid epidemiological analysis of incidents. The WGS database continues to expand and current data show that there are over ten clusters within Cheshire currently with identical individual strains. These clusters are not always clearly geographically defined and may overlap. In the south of the county there were several new incidents with defined clusters of spoligotypes 9:d and 25:a.

Information gathered at the disease investigation visit, looking at farm management and cattle movements is used to determine which incidents were most likely to be associated with a wildlife source (Figure 7). Clustering of TB incidents to the east and south of Cheshire corresponds with the highest cattle densities, and with previous findings of infection in 21% of found dead badgers from Cheshire submitted in the 2014 University of Liverpool survey. In that survey, the same genotypes of *M. bovis* were found in cattle and badgers. However, the direction of transmission could not be determined from these data.

The available evidence suggests that there are endemically infected badger populations in Cheshire. Further studies and whole genome sequencing will greatly add to our knowledge.

From the map in Figure 8, there appears to be an abundance of incidents with the most likely source attributed to wildlife, especially in the south Cheshire area. There are also some to the east of the county, although fewer than in previous years. The locations appear to be consistent with the published University of Liverpool survey findings showing the infected badger locations (<https://tbhub.co.uk/preventing-tb-breakdowns/about-bovine-tb/bovine-tb-research-and-development/badger-found-dead-survey-in-the-edge-area/>). There are relatively fewer incidents attributed to movements of undetected infected cattle which are more sporadic in nature, as expected, and a few attributed to local cattle movements. Some are undetermined sources and this may be due to the fact that the incident is not yet concluded or no single source could be attributed. For example, the herd may have experienced a previous incident with the same genotype, it may be an OTF-S incident with no genotype information, or the possible transmission pathways could be equally weighted to multiple sources. If the genotype is the same as in previous incidents, the source/risk pathway can be unclear because residual infection, cattle movements or infected wildlife could be equally attributed.

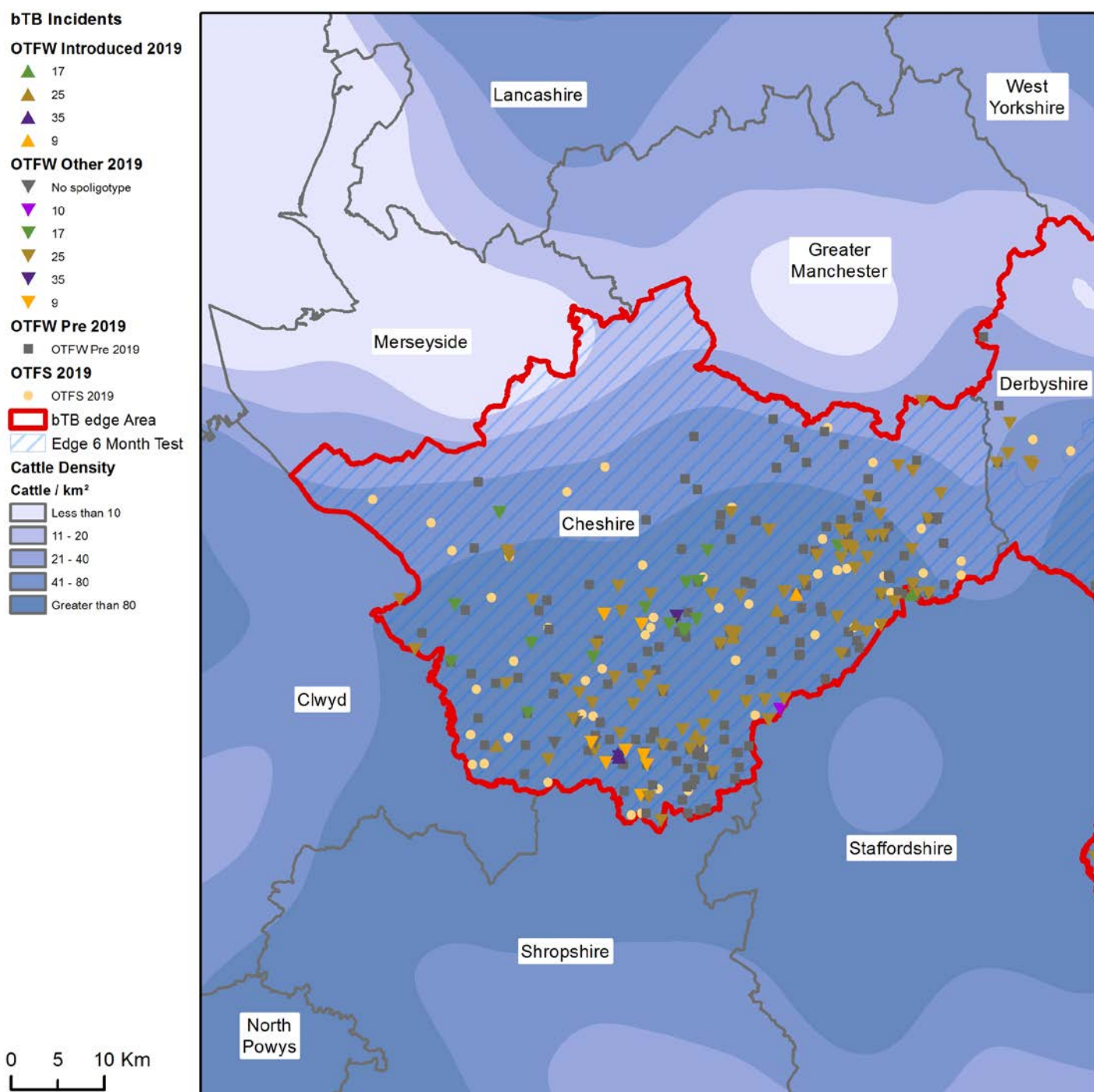


Figure 6: Location of cattle holdings in Cheshire with new TB incidents (OTF-W and OTF-S) in 2019 and cattle holdings with pre-2019 OTF-W incidents that are still ongoing at the beginning of 2019, overlaid on a cattle density map. To note, 'OTF-W Introduced 2019' refers to OTF-W incidents in which introduction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

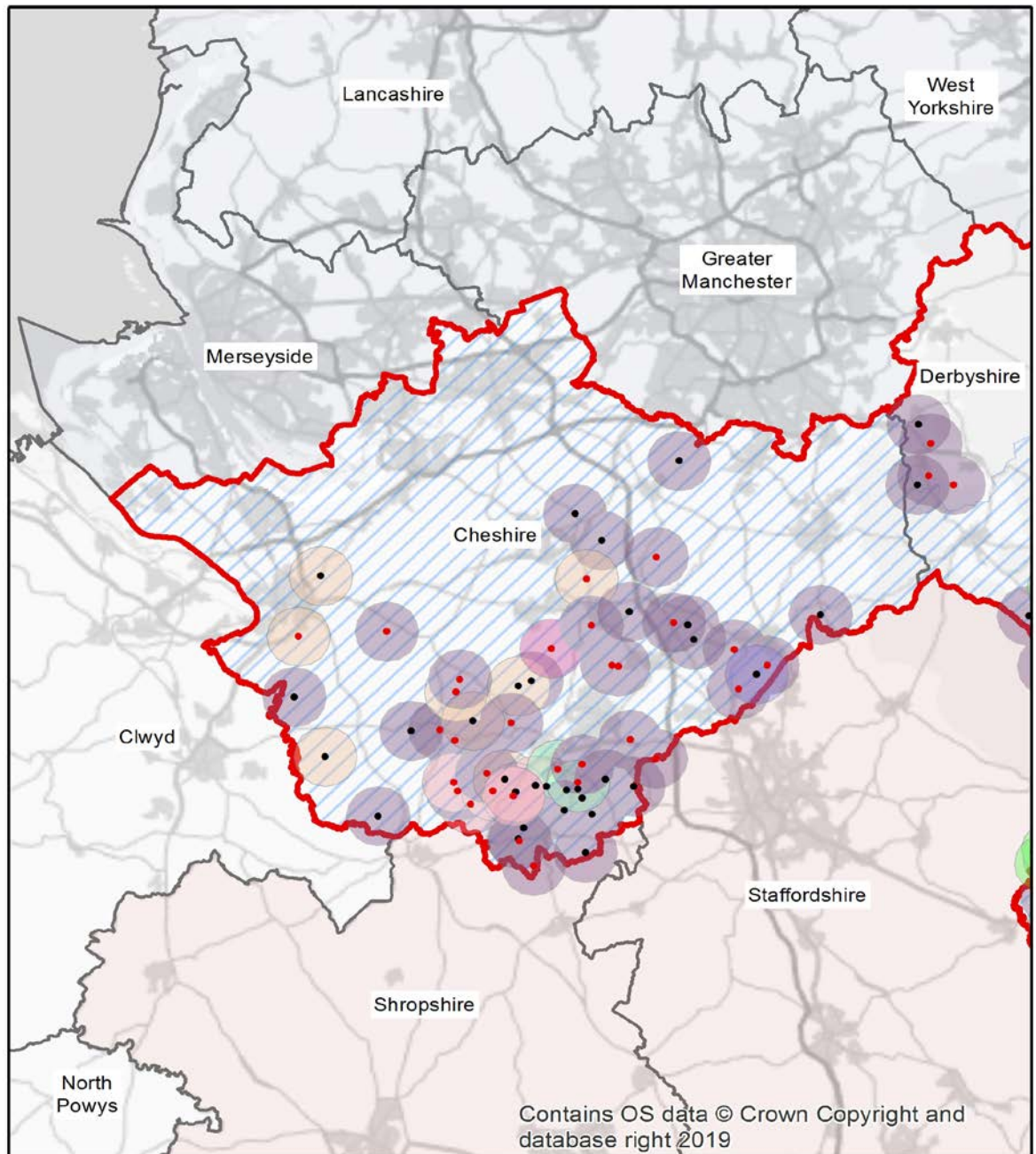
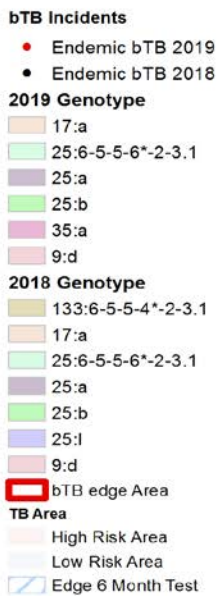


Figure 7: Genotypes of *M. bovis* detected in Cheshire in 2018 and 2019, where a wildlife source was attributed with a 75% certainty or above, as an indication of endemic infection within local wildlife populations (OTF-W incidents only).

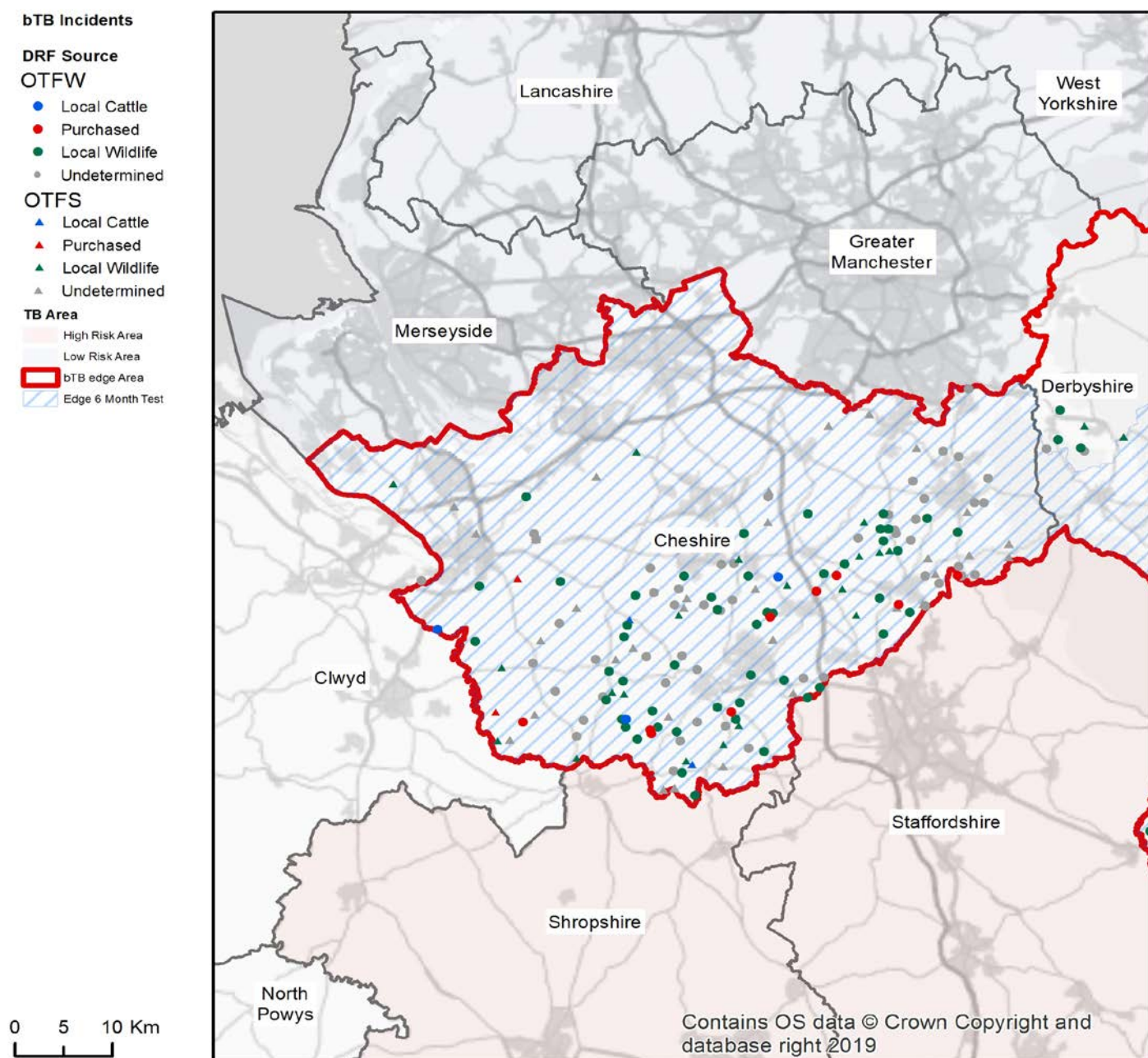


Figure 8: Map of the source of infection pathway recorded with the highest level of certainty for all TB incidents (OTF-W and OTF-S) in Cheshire, and its adjoining Edge Area counties, which started in 2019.

Other characteristics of TB incidents

Incidents by herd types

Herds with fewer than 100 cattle (53% of herds in Cheshire) were responsible for 20% of new incidents in 2019 (Figure 9). Herds with more than 350 cattle (16% of herds in Cheshire) were responsible for 43% of new incidents. This is consistent with herd size being a risk factor for TB infection. The majority of the larger herds are also likely to be dairy herds, which as a group accounted for 72.6% of all TB incidents. Beef fattener herds accounted for 16% of all incidents in Cheshire in 2019 (excluding incidents in AFUs) and beef suckler herds accounted for 10% of incidents. These proportions are consistent with the predominance of dairy cattle in the county.

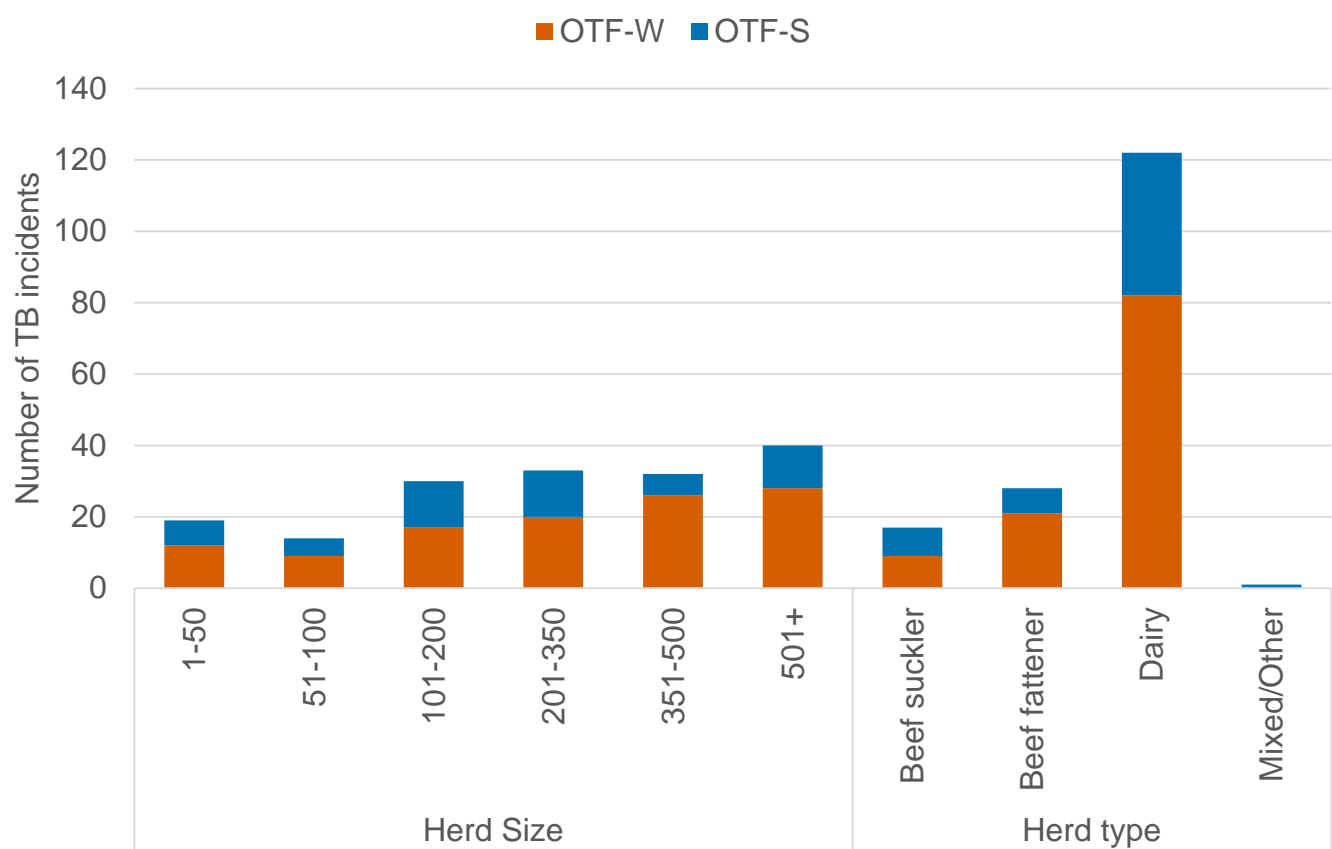


Figure 9: Number of new TB incidents (OTF-W and OTF-S) in Cheshire in 2019, by cattle herd size and type.

Incidents by month of disclosure

The effects of seasonality have diminished with the continuation of routine six-monthly herd testing. There is still a slight seasonal effect with fewer incidents disclosed in March, April, August and December (Figure 10). This may be partly explained by farmers preferring to complete their herd tests before spring turnout if their testing window permits this. There is also a natural break in TB

testing due to the Bank Holidays over the Christmas and New Year period which may account for the dip in detection in December. The greatest number of incidents occur during late autumn and the winter housing period which, as in previous years, suggests detection of infection acquired during the grazing period.

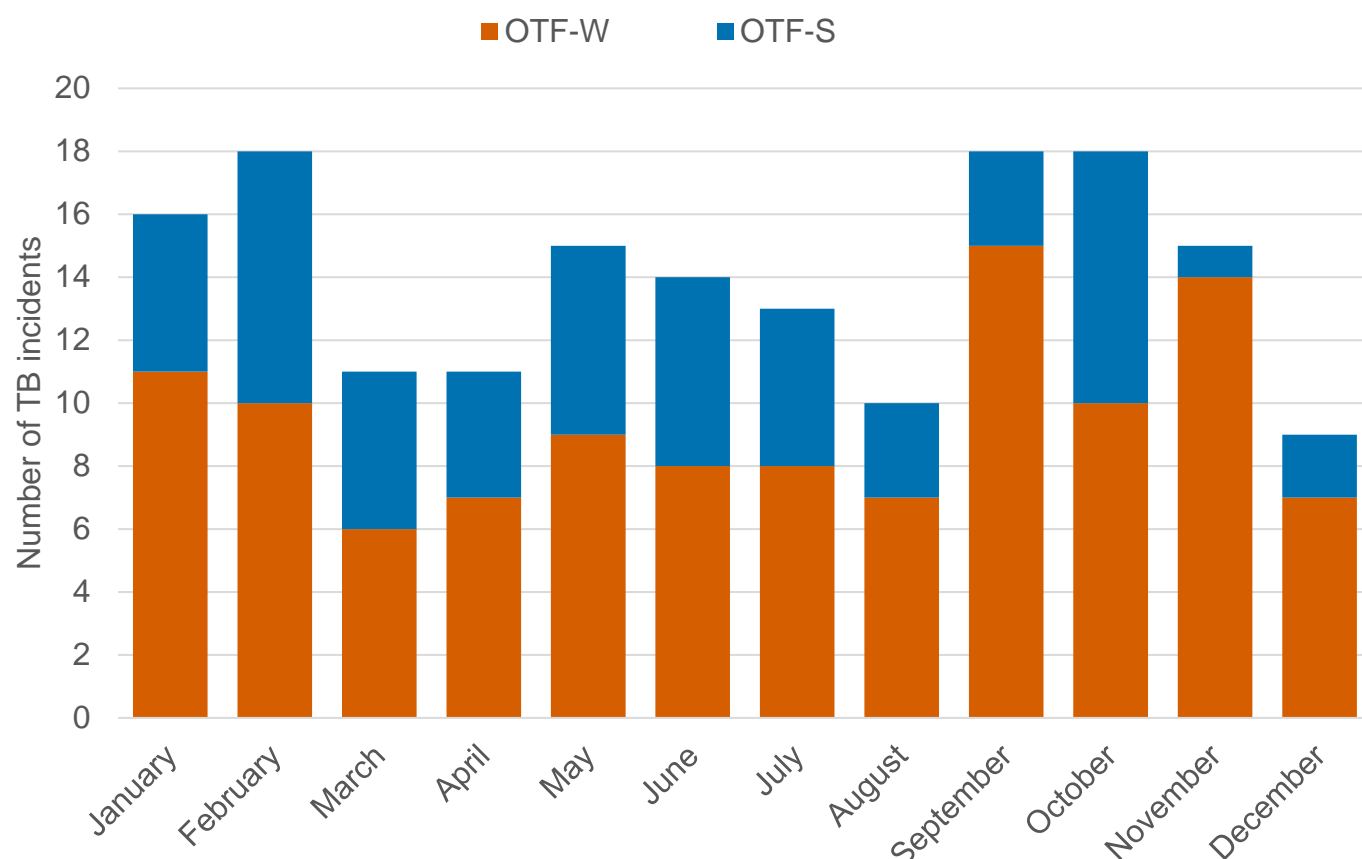


Figure 10: Number of new TB incidents (OTF-W and OTF-S) in Cheshire in 2019, by month of disclosure.

Genotypes of *M. bovis* isolated

Genotype 25:a continues to be the predominant local genotype in Cheshire, isolated from 72 (66%) new OTF-W incidents in 2019 (Figure 11). Genotype 17:a, the second local genotype, accounted for 16 (15%) of new OTF-W incidents. A new genotype, 9:d, is developing as a third local genotype, being isolated in nine (8%) of the new OTF-W incidents in Cheshire during 2019. This new emerging genotype was initially possibly introduced by undisclosed movement of cattle from Wiltshire. Other possibilities are also being investigated. Local spread has occurred since, and the involvement of badgers is suspected.

Only one sample is routinely genotyped from each new OTF-W incident and therefore these figures do not account for incidents with mixed infections. Two incidents disclosed in 2019 had known mixed infections: a dairy farm with genotypes 25:a and 9:d and a beef unit with genotypes 17:a and 25:a.

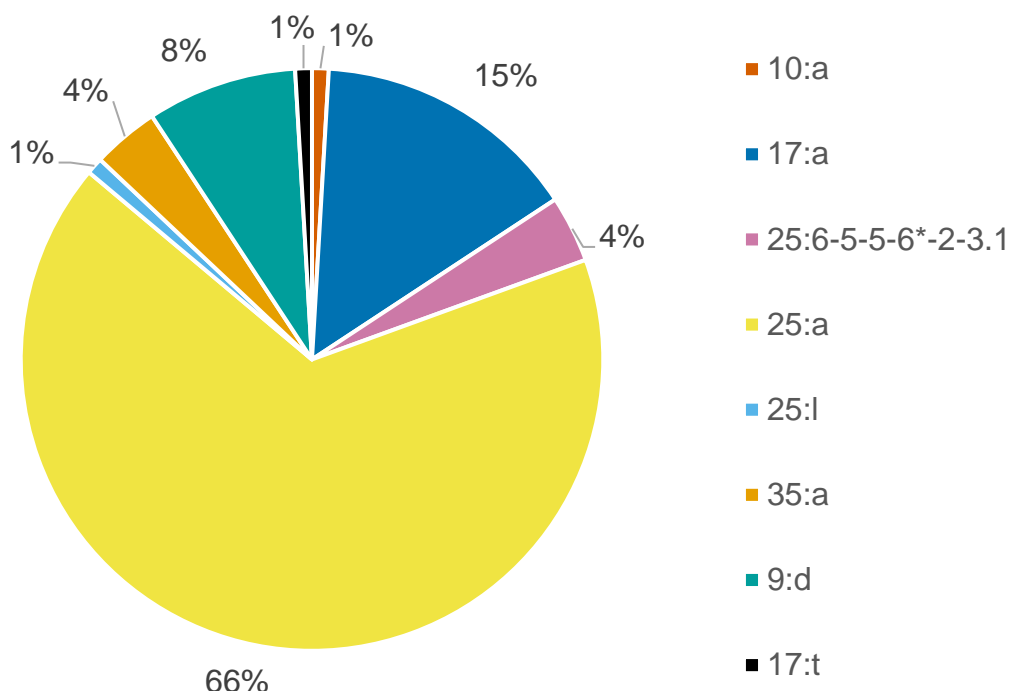


Figure 11: Genotypes of *M. bovis* identified in herds with OTF-W incidents in Cheshire in 2019 (n=108).

Duration of incidents

The majority of incidents which closed in 2019 (62%) lasted between 151 and 240 days (Figure 12). The average duration of all incidents which closed in 2019 was 329 days for OTF-W and 226 days for OTF-S. The median length of OTF-W incidents was 272 days which is an increase of 40 days from 2018.

Nine incidents which had been experiencing persistent infection (those with an incident duration of 18 months or more), and had been undergoing enhanced case management, were closed in 2019. Five other incidents were still ongoing at the end of 2019, but progress was made through a series of actions undertaken including bespoke biosecurity advice provided by the TB Advisory Service, restriction on restocking licences, and deployment of supplementary IFN- γ testing.

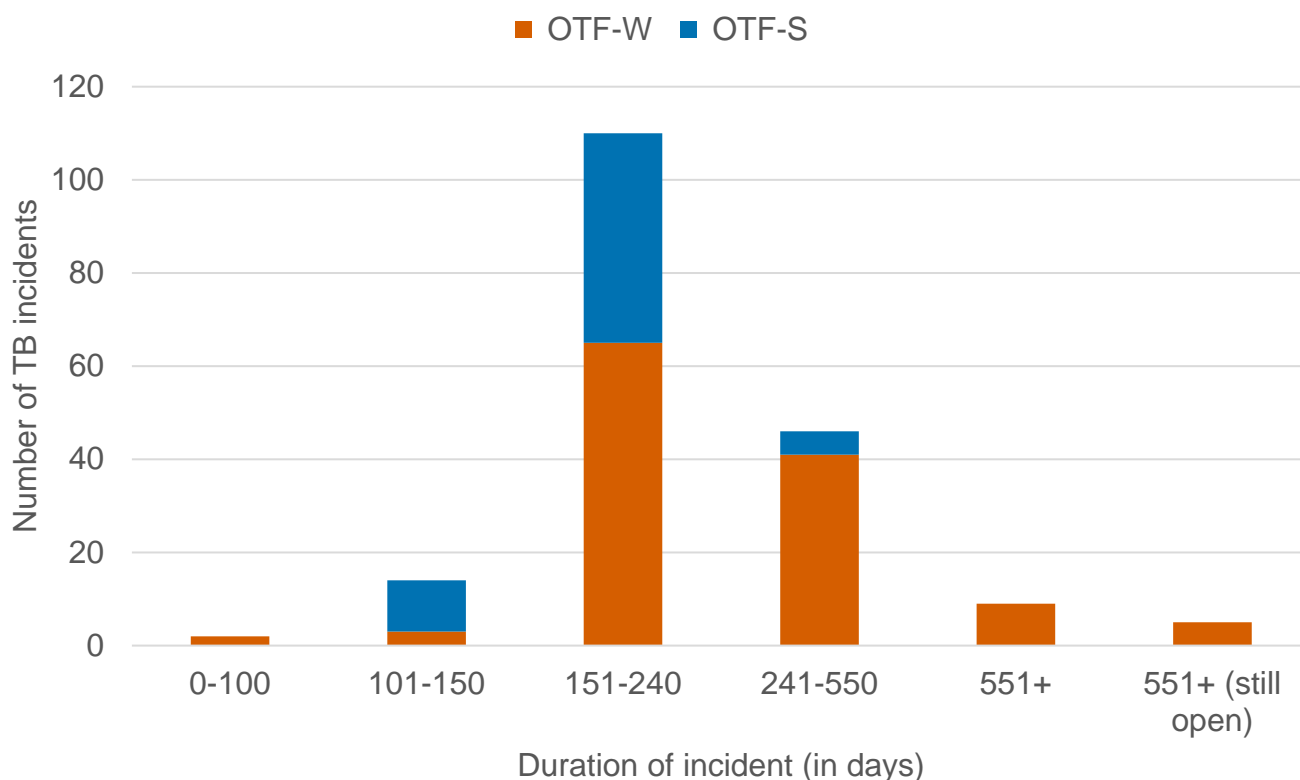


Figure 12: Duration of all TB incidents (OTF-W and OTF-S) that ended in 2019, and the number of persistent TB incidents (551+ days) that were unresolved at the end of 2019 in Cheshire. Note that Approved Finishing Units (AFUs) have been excluded.

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). However, where resource constraints preclude visiting all affected premises, a combination of random selection and 'triage' is used to identify those premises which require an investigation visit. 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 Cheshire in 2019 are as follows:

- Infected wildlife
- Infected cattle

A reservoir of infection in wildlife, particularly badgers, is thought to be one of the key drivers of the epidemic in Cheshire. No cases of TB have been reported in wild deer in Cheshire in recent years although historically several cases of TB infection had been confirmed in the wild deer population near Congleton.

Residual infection can result from undisclosed infection in cattle herds in the former HRA portion of the county where IFN- γ testing in OTF-W incidents did not become mandatory until 2018. The continued use of IFN- γ testing in combination with skin testing is maximising the chances of detecting and removing infected cattle.

The use of markets appears to be diminishing as many dairy replacements are sourced from outside the UK, from OTF countries as well as from the Republic of Ireland. Farmers using markets are becoming more aware of the risks of buying cattle of unknown TB risk status. Many of the flying dairy herds source cattle from lower risk areas of the UK, via markets or directly from farms.

There are many fragmented large herds in Cheshire which rely on frequent movements of cattle between sites. However, the analysis of new incidents in 2019 shows that infected wildlife is more likely to be the source of infection than cattle movements within these enterprises.

Sources of infection and risk pathways

Infected badgers were considered to be involved in approximately 60% of both OTF-W (Figure 13a) and OTF-S (Figure 13b) weighted source pathways identified in Cheshire in 2019, with cattle movements (either locally or purchased from other risk areas) involved in 17% of OTF-W weighted

source pathways and almost 10% of OTF-S weighted source pathways. Residual infection in the herd was attributed in around 11% of OTF-W weighted source pathways and was usually attributed in new incidents occurring at the 6M post-incident herd test with an identical genotype isolated. Residual infection was attributed to approximately 6% of OTF-S weighted source pathways.

Overall only 2.4% of weighted source pathways were attributed to contiguous cattle contact (where neighbouring cattle groups may have nose-to-nose contact) as seen in Appendix 4. Anecdotally, this appears to be less of a risk as farmers are now more aware of reducing cattle-to-cattle contact due to the risks posed by other diseases in addition to TB. Many will not graze cattle in contiguous fields and prefer to have an arable break between holdings or may use paddock rotations to avoid cattle being on contiguous fields at the same time.

Occasionally it is not possible to differentiate between several plausible sources such as residual infection, infected wildlife, or movements of undetected infected cattle as all three may be suspected. This is often classed as other or unknown source.

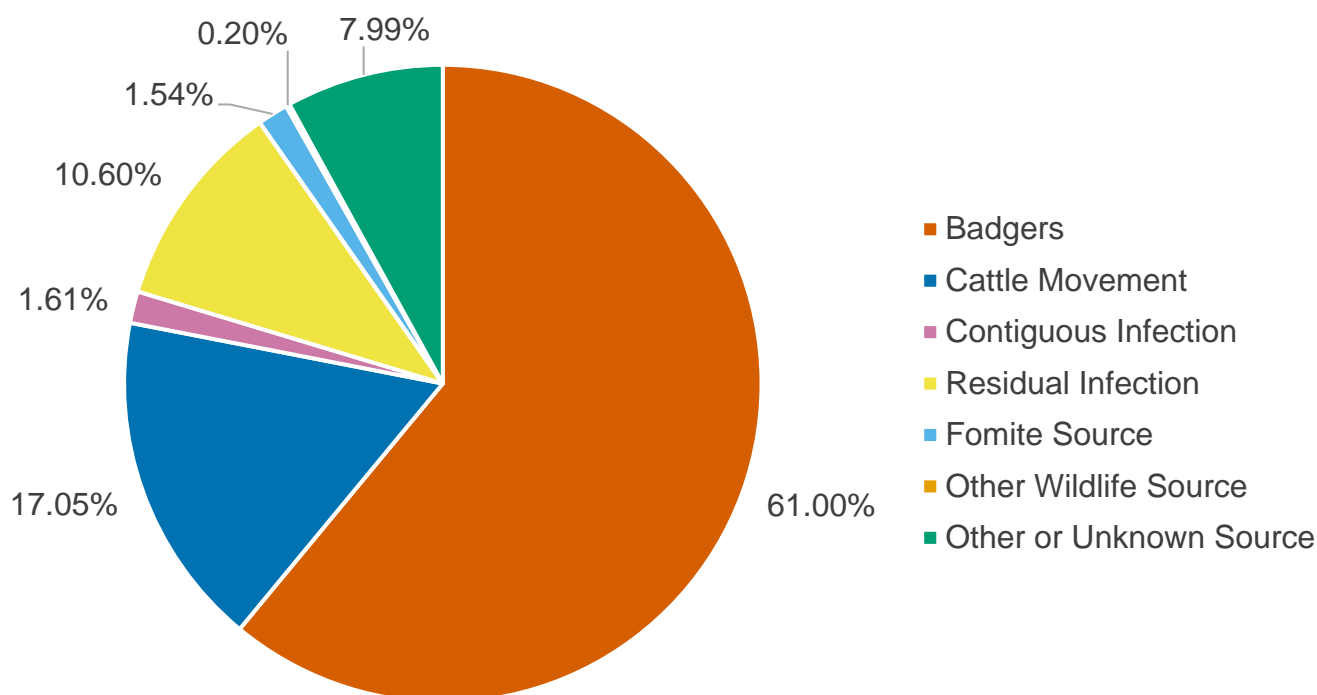


Figure 13a: Summary of the weighted source of infection pathways attributed for all OTF-W incidents in Cheshire that started in 2019, that had a completed DRF (73).

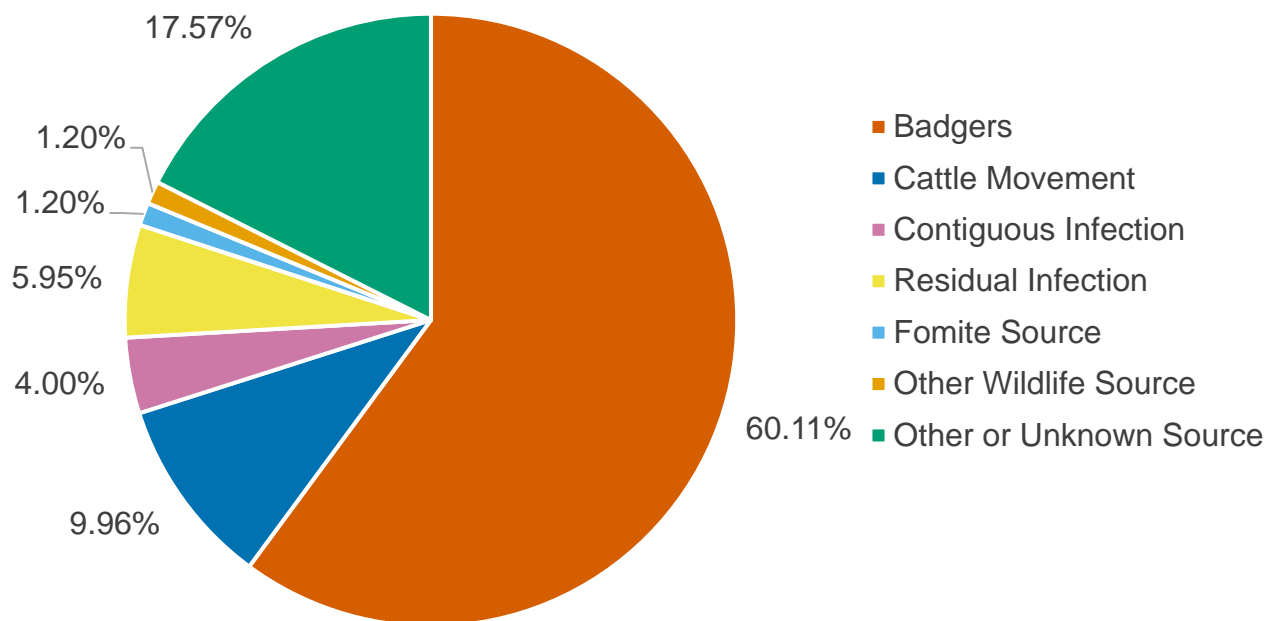


Figure 13b: Summary of the weighted source of infection pathways attributed for all OTF-S incidents in Cheshire that started in 2019, that had a completed DRF (37).

As shown in Figure 14, in beef fattener herds (excluding AFUs without grazing) movements of cattle accounted for almost 21% of all incidents. This is to be expected as these herds rely on regular purchase of replacements. Wildlife was attributed as the most likely source in 14% of cases.

In beef suckler herds, exposure to wildlife sources was attributed in 35% of all incidents. This is consistent with the husbandry of these herds where there are fewer cattle purchases and all cattle are grazed, thereby increasing the risk of contact with wildlife infection.

In dairy herds, 46% of all incidents were attributed to wildlife and only 4% attributed to cattle movements. Again, this shows consistency with dairy herd management such as minimal or no purchase of cattle by many herds, and intensive paddock grazing or zero grazing, potentially leading to increased indirect contact with badgers via contamination of paddocks or harvested fresh grass.

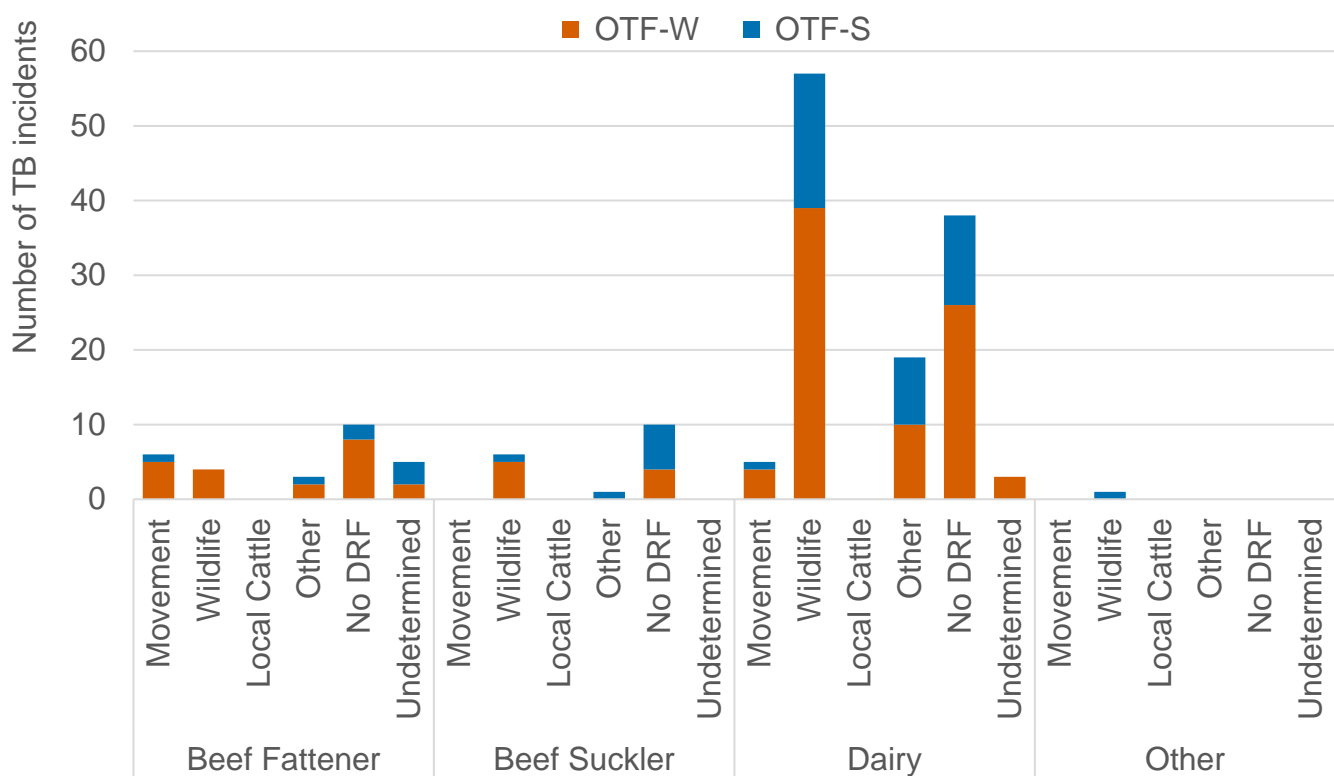


Figure 14: Source of infection recorded with the highest level of certainty for all TB incidents (both OTF-W and OTF-S) in Cheshire in 2019, by herd type. Note that the categories 'movement', 'wildlife', and 'local cattle' are comprised of incidents where these were the most likely single source of infection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

Anecdotal evidence suggests that Cheshire has a high density badger population. The majority of farmers report observations of badger activity on farm and on surrounding land. Knowledge of badger ecology and awareness on farms has been greatly increased since the beginning of licenced badger control in some areas of Cheshire during 2017. As shown in Figures 7 and 8 previously, many of the incidents in 2019 were attributed to infected badgers due to the evidence from previous badger found dead surveys by the University of Liverpool (<https://tbhub.co.uk/preventing-tb-breakdowns/about-bovine-tb/bovine-tb-research-and-development/badger-found-dead-survey-in-the-edge-area/>) and the level of observed badger activity on farm, after infected cattle sources had been ruled out.

It is considered that badgers play a role in TB transmission in parts of Cheshire due to the lack of evidence of inward high risk cattle movements and TB history in some herds, and lack of contact between neighbouring herds. For example, there were new incidents in herds with no history of TB where all replacement cattle were homebred and artificial insemination is used. WGS analysis is also adding to the evidence of spatial separation of cattle herds with identical strains of TB in the absence of evidence of cattle movements between areas.

Wild deer are present north of Congleton and Macclesfield and may play a role in some cases, although no new incidents of TB have been reported in wild deer recently. Incidents due to wildlife infection were reported in the neighbouring Edge Area county of Derbyshire as shown in Figure 8. This is a potential concern to the neighbouring parishes in Cheshire where there were suspected wildlife sources reported in 2018 in OTF-S incidents.

Detection of incidents

With six-monthly routine whole herd testing (WHT) being carried out in the original Cheshire Edge Area since 2015 and since January 2018 in the former Cheshire HRA, infection is likely to be disclosed sooner relative to other areas of the country with lower frequency herd testing. This allows less time for disease to spread within the herd and reduces transmission to other cattle herds and wildlife.

The majority (55%) of new incidents in 2019 were disclosed at routine herd surveillance testing as shown in Figure 15. Fewer incidents were disclosed at the WHT than in the previous two years (94 in 2019 compared to 118 in 2018 and 128 in 2017). The 6M herd check test, which is carried out six months after an incident has ended, disclosed 39 new incidents. More incidents were disclosed in 2019 using this test type than in the previous years (18 in 2017 and 29 in 2018). This may reflect residual infection in a herd (less likely following IFN- γ testing) or another ongoing source of infection on the premises. Another reason for disclosure of incidents was passive surveillance at slaughterhouses (SLH). The number of both suspected and confirmed slaughterhouse cases rose in 2019. A total of 53 suspect slaughterhouse cases were reported by the Food Standards Agency and of these, 30 were culture positive for *M. bovis*, which in turn triggered 21 new incidents. This may be due to improvements in slaughterhouse surveillance or infection in cattle which have moved into Cheshire from other areas subject to less frequent testing.

In Cheshire, an incident is more likely to occur in herds which have been infected in the preceding three years compared to those herds which have not. In 2019, almost 60% of both OTF-W (63) and OTF-S (33) herds with an incident in 2019 had a history of TB infection in the previous three years (Figure 16). The reasons for recurrence can be variable depending on herd activity and distribution within Cheshire. Using more than one round of parallel skin and IFN- γ testing in incident herds further reduces the likelihood of residual infection in cattle. Infected cattle, the contamination of feed or the environment can lead to re-infection within a herd and further spread. In areas of high incidence of TB, badgers can play a role in maintaining TB in cattle herds through environmental contamination. When a herd regains OTF status and movement restrictions are removed, cattle movements may

occur which may also increase the risk of reinfection with TB (purchases or movements of cattle between holdings under the same ownership within large enterprises).

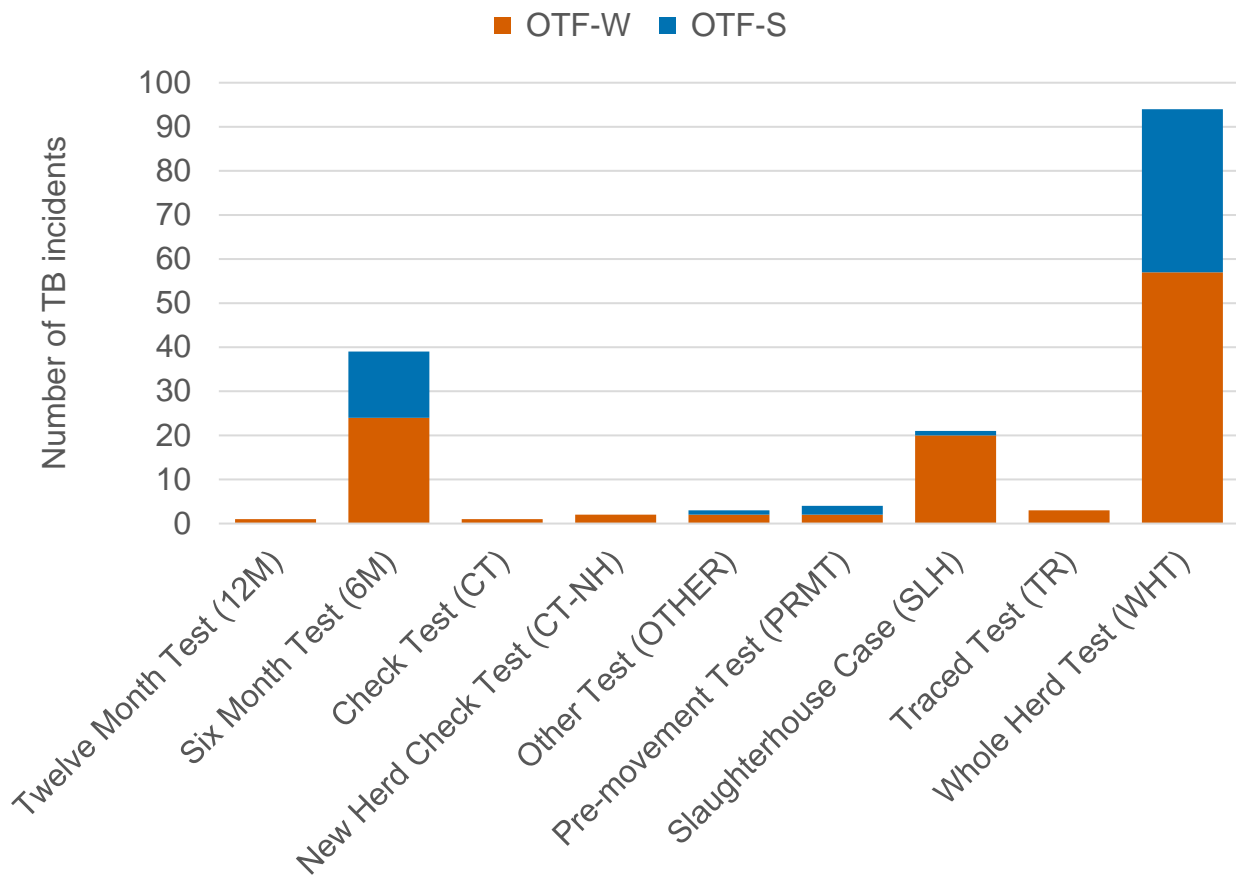


Figure 15: Number of TB incidents (OTF-W and OTF-S) in Cheshire in 2019, disclosed by different surveillance methods.

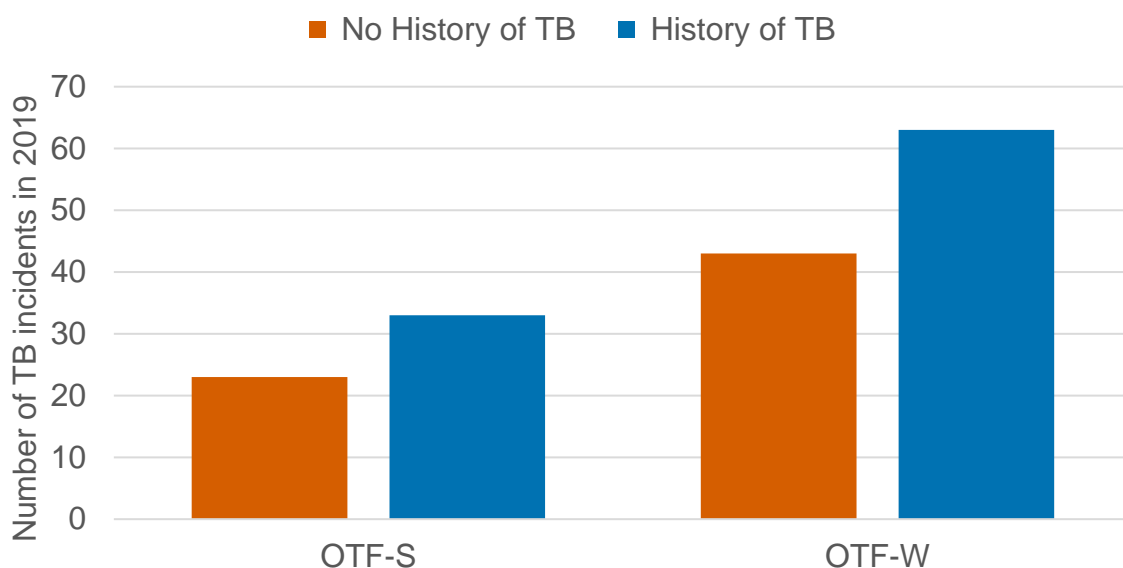


Figure 16: Number of TB incidents (OTF-W and OTF-S) in Cheshire in 2019 on holdings that have suffered an OTF-W incident in the previous three years, and holdings with no history of TB in the previous three years.

Skin test reactors and interferon gamma test positive animals removed

The burden of TB in Cheshire is considerable in terms of the number of incidents at any one time and the number of cattle being slaughtered for TB control. An average of 12 cattle were removed per incident and 3.6 reactors identified per 1000 animals tested in 2019, at similar levels to 2017 and 2018 (see Appendix Table A3.2). TB incidents impact on the ability to move cattle off the incident premises. Likewise, it can prove difficult to source cattle to replace reactors which have been slaughtered, especially following the removal of large numbers of reactors at disclosing tests when cattle are not permitted to move on before the results of the first incident test have been assessed. The economic losses to dairy farms in the case of lost milk yield can be further impacted by financial penalties imposed by the dairies through breaches of contract and not meeting forecasted milk yields.

Many of the larger dairy farms in the county operate over several geographically discrete sites and TB incidents can make management of the herd complex. This can be exacerbated when separate heifer rearing premises are used, many of which may not be equipped to deal with calving or milking cattle.

For beef herds that rely on selling stores rather than finishing, TB can have a significant economic impact resulting in cash flow problems and possible overstocking. The existence of AFUs and TB Isolation Units can lessen the impact.

A total of 2,059 reactor cattle were slaughtered in Cheshire during 2019. Of these, 52% (1,080 cattle) were IFN- γ test positives and 48% (979 cattle) were skin test reactors (Figure 17). Prior to 2018, skin test reactors constituted the greater proportion of reactors disclosed in the county. Total numbers of

cattle removed for TB control more than doubled from 2015 (1,109) to 2018 (2,231) but reduced slightly to in 2019 (2,059).

An additional 43 cattle (Appendix Table A4) were slaughtered for other TB control reasons (direct contacts and private slaughter). This is fewer than in 2018 when 54 cattle were slaughtered for other TB control reasons.

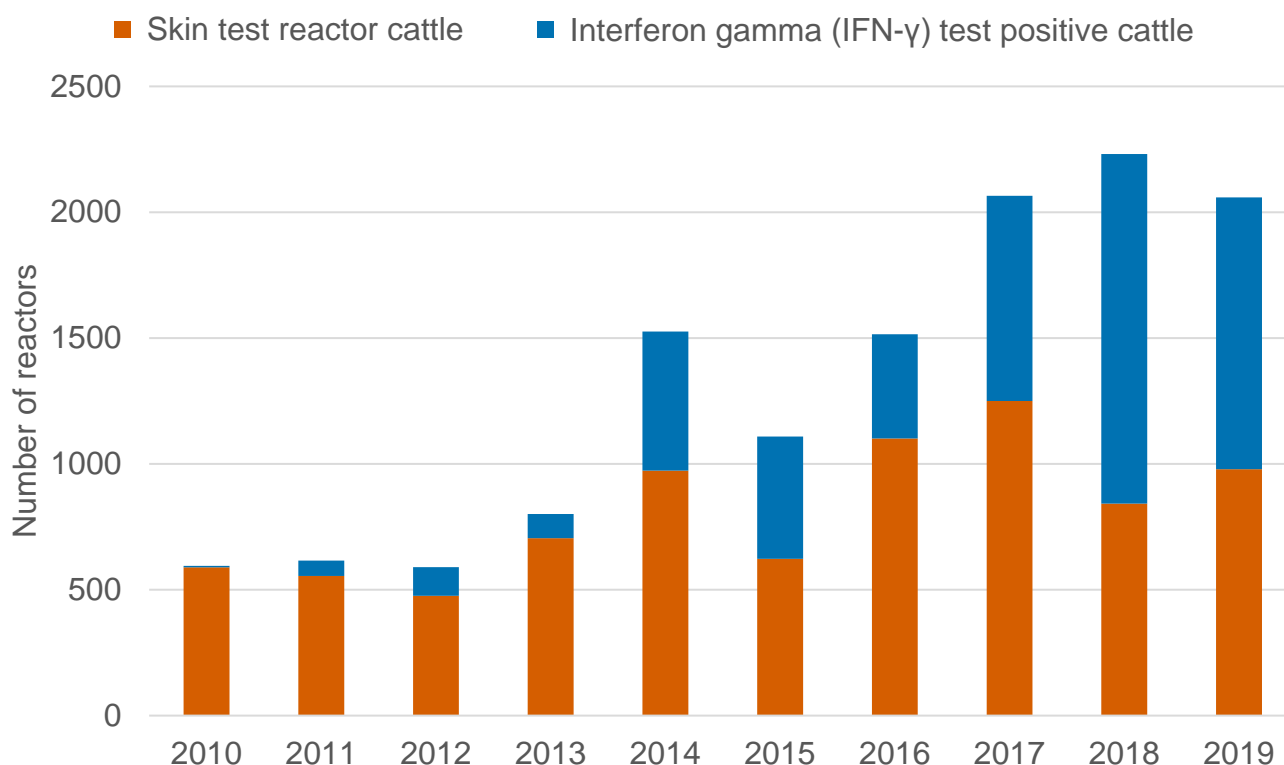


Figure 17: Number of skin test reactors and interferon gamma (IFN-γ) test positive cattle removed by APHA for TB control reasons, in Cheshire, 2010 to 2019.

Summary of risks to Cheshire

There are four main areas of threat from bordering counties, namely north-east Wales; north Shropshire, north Staffordshire and north-west Derbyshire. There are no geographical barriers other than the River Dee between Cheshire and Wales for part of the border and this is often a flood plain. Main roads and bridges link the two areas in many places so there is potential for not only cross border cattle trade and movements, but also movement of infected wildlife if present on either side. There are no significant physical barriers between Cheshire and the northern parishes of Shropshire, Staffordshire, and Derbyshire. There is evidence of infection in badgers from the 2014 found dead badger survey in Cheshire (<https://tbhub.co.uk/preventing-tb-breakdowns/about-bovine-tb/bovine-tb-research-and-development/badger-found-dead-survey-in-the-edge-area/>) especially bordering Shropshire and Staffordshire.

The key risks to Cheshire are local spread via local cattle movement/contact and wildlife, and longer range cattle movement, especially from high risk areas of the country.

Summary of risks from Cheshire to surrounding areas

There is a continuing risk to the LRA particularly the Stockport area of Greater Manchester from north-east Cheshire. The Cheshire parishes of Mebberley, Wilmslow and Poynton which border Greater Manchester pose the greatest risk.

Two OTF-S incidents were identified in these parishes in 2019. Most likely risk pathways included exposure at grazing to infected badgers or residual infection within the herd.

In 2016, a number of infected badgers were found in the bordering LRA parishes. Cattle may also move to the LRA from Cheshire via markets or directly from farm-to-farm (<https://tbhub.co.uk/preventing-tb-breakdowns/about-bovine-tb/bovine-tb-research-and-development/badger-found-dead-survey-in-the-edge-area/>). Post-movement TB testing is mandatory in the LRA and these cattle are also pre-movement TB tested if they are eligible which reduces the risk of movements of undetected infected cattle. Further information on eligibility is available on Tb Hub (www.tbhub.co.uk).

Assessment of effectiveness of controls and forward look

Continuation of the increased TB control measures in cattle and appropriate badger control measures are required to reduce infection in the county. It may take some years before the benefits are realised but they are required to decrease the risks of disease spread to other parts of Cheshire and beyond.

Biosecurity awareness is increasing through communications with the farmers' own veterinary providers and TB Advisory Service visits. Awareness of risks has also improved through the badger culls with increased knowledge of badger locations and the likely risks to and from livestock. The ibTB interactive TB mapping tool (www.ibtb.co.uk) and TB Hub website (www.tbhub.co.uk) are valuable sources of information for farmers and stakeholders.

With the current whole county herd incidence rate (per 100 herd years at risk) at levels equivalent to the total HRA herd incidence and the TB incidence (per 100 unrestricted herds) at 12.6, it is unlikely that OTF status will be achieved by 2025 which has a requirement for crude incidence of indigenous OTF-W herd incidents to be <0.1%.

Appendices

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

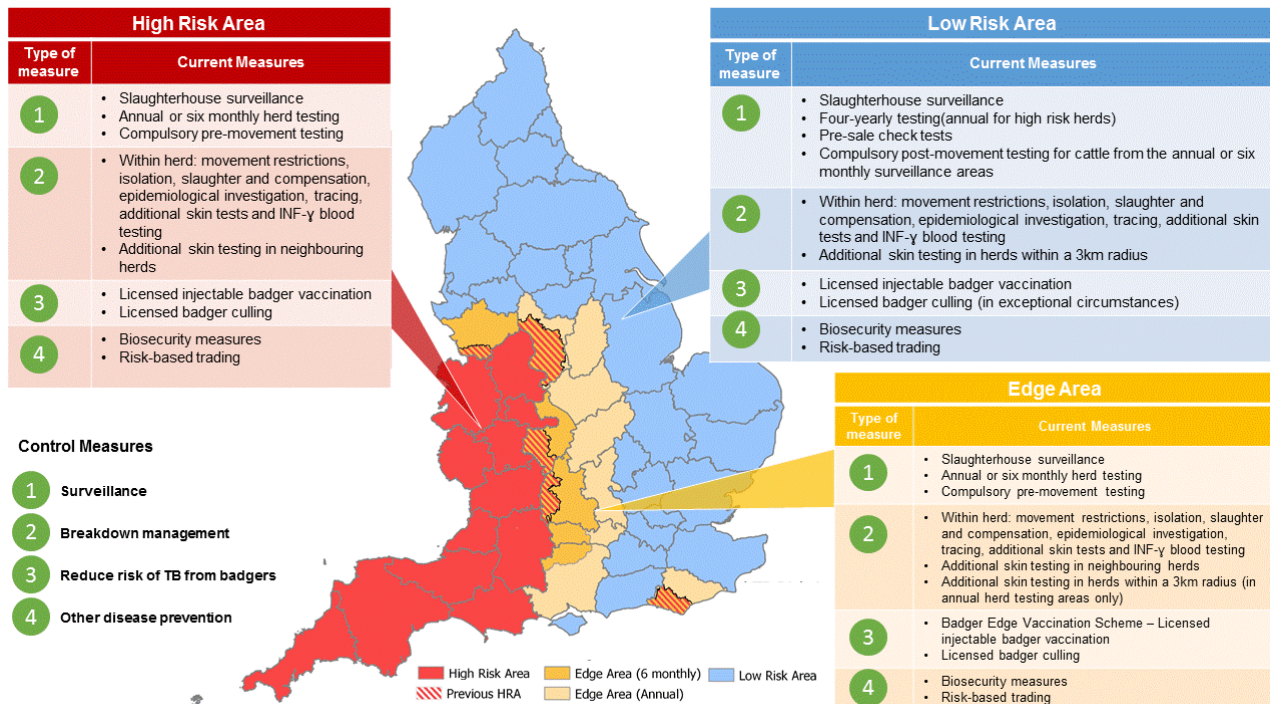


Figure A1: TB risk and surveillance areas of England effective since January 2018, as set out in the Government's Strategy for Achieving Officially Bovine Tuberculosis Free status for England. Map based on information published on www.tbhub.co.uk.

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 Cheshire

Edge Area testing policy:

- Six-monthly herd surveillance testing is now effective across the whole county of Cheshire. Previously the original Edge Area had been subject to six-monthly testing since 2015 but the former HRA portion had been annually tested until January 2018. From May 2019 cattle herds became eligible for annual surveillance testing if they met either of the following criteria:
 - The herd has been in existence for at least six years and has not had a TB incident in that six year period. A single break from keeping cattle of less than four months during the six year period is permitted
 - The herd is registered to a bovine TB health scheme accredited under the Cattle Health Certification Standards (CHeCS) at level 1 or above
- No radial testing requirement in Cheshire
- All incidents in Cheshire require at least two consecutive short interval tests at severe interpretation with negative results before OTF status can be regained
- Mandatory IFN- γ testing is deployed in all new OTF-W incident herds
- Private slaughter of inconclusive reactors is encouraged in OTF-W incident herds along with removal of higher risk in contact cattle as direct contacts (DCs) where appropriate
- Exemptions to IFN- γ testing are applied where there is clear epidemiological separation of certain groups of cattle within the herd after the initial round of testing thus making it more targeted and cost-effective
- Five herds with persistent infection were still subject to enhanced case management measures at the end of 2019 and nine resolved in 2019

Other testing measures:

- Any fattening herds exempted from routine surveillance testing must meet a strict set of criteria:
 - All animals sold direct to slaughter or via a slaughter gathering
 - No animals to be resident on the holding for more than 12 months
 - No births in the unit
 - No breeding activity in the unit
 - All cattle must be permanently housed
- No contiguous testing in Cheshire as all farms are on routine six-monthly surveillance testing, apart from those with earned recognition. In contiguous farms with earned recognition, a veterinary risk assessment is done on an individual case level to determine the need for contiguous testing
- Compliance with statutory TB testing in Cheshire is good

Other control measures:

- Farmers are encouraged to take advantage of free of charge TB Advisory Service (TBAS, www.tbas.org.uk/) visits
- Targeted APHA auditing of Official Veterinarian (OV) delivery of skin testing is undertaken with corrective actions being taken as necessary
- There is a good working relationship between APHA and Local Authority officers regarding any TB compliance and cattle identity issues
- Licensed badger culling took place in parts of Cheshire in 2019

Appendix 2: cattle industry in Cheshire

Table A2.1: Number of cattle premises by size band in Cheshire 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	11	774	515	186	198	207	101	1320	178	82

*The number of herds with an undetermined size.

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

Breed purpose	Beef	Dairy	Dual purpose	Unknown	Total
Number of Cattle	61,915 (26%)	160,161 (68%)	12,338 (5%)	17 (<0.01%)	234,431

Appendix 3: summary of headline cattle TB statistics

Table A3.1: Herd-level summary statistics for TB in cattle in Cheshire 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	1594	1537	1527
(b) Total number of whole herd skin tests carried out at any time in the period	2721	2771	2324
(c) Total number of OTF cattle herds having TB whole herd tests during the period for any reason	1334	1276	1242
(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)	1396	1336	1344
(e) Total number of cattle herds that were not under restrictions due to an ongoing TB incident at the end of the report period	1457	1403	1405
(f) Total number of new TB incidents detected in cattle herds during the report period, (including all FUs)	181	179	168
• OTF-S	59	57	56
• OTF-W	122	122	112
(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?	10	6 (includes 5 AFU)	9
• New OTF-W incidents triggered by skin test Reactors or 2xIRs at routine herd tests	84	81	82

Herd-level statistics	2017	2018	2019
<ul style="list-style-type: none"> New OTF-W incidents triggered by skin test Reactors or 2xIRs at other TB test types (forward and back-tracings, contiguous, check tests, etc.) 	24	26	10
<ul style="list-style-type: none"> New OTF-W incidents first detected through routine slaughterhouse TB surveillance 	13	14	20
(h) Number of new incidents revealed by enhanced TB surveillance (radial testing) conducted around those OTF-W herds	n/a	n/a	n/a
<ul style="list-style-type: none"> OTF-S 	n/a	n/a	n/a
<ul style="list-style-type: none"> 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)	103	100	91
(j) New confirmed (positive <i>M. bovis</i> culture) incidents in non-bovine species detected during the report period (indicate host species involved)	2 cats	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	24	27	29
Exempt Finishing Units: Grazing	3	3	2
Exempt Finishing Units: Non Grazing	4	4	4

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)	546,093	587,898	568,202
(b) Reactors detected in tests during the year:			
• Tuberculin skin test	1250	842	979
• Additional IFN- γ blood test reactors (skin-test negative or IR animals)	815	1,389	1,080
(c) Reactors detected during year per incidents disclosed during year *	11.4	12.5	12.3
(d) Reactors per 1000 animal tests	3.8	3.8	3.6
(e) Additional animals slaughtered during the year for TB control reasons:			
• DCs, including any first-time IRs	75	42	33
• Private slaughters	6	12	10
(f) SLH cases (tuberculous carcasses) reported by Food Standards Agency (FSA)	26	37	53
(g) SLH cases confirmed by culture of <i>M. bovis</i> **	14	19	30

* 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 Cheshire, in 2019.

Source of infection	Possible (1)	Likely (4)	Most likely (6)	Definite (8)	Weighted contribution
Badgers	43	65	49	1	60.7%
Cattle movements	23	16	6	2	14.7%
Contiguous	8	4	0	0	2.4%
Residual infection	24	10	5	0	9.0%
Domestic animals	0	0	0	0	0.0%
Non-specific reactor	0	0	0	0	0.0%
Fomites	8	0	1	0	1.4%
Other wildlife	1	1	0	0	0.5%
Other or unknown source	1	0	0	0	11.2%

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



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