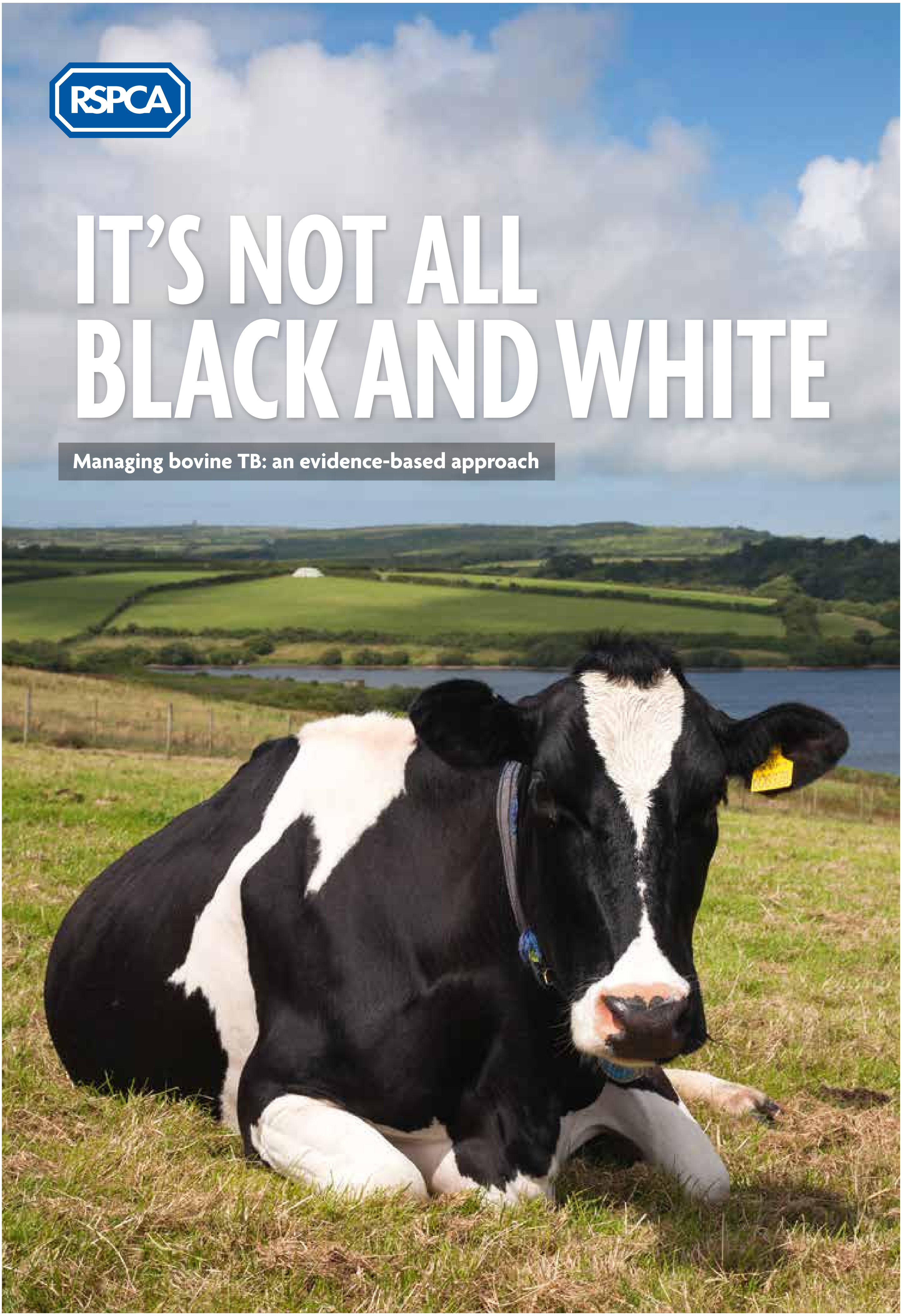
RSPCA

IT'S NOT ALL BLACK AND WHITE

Managing bovine TB: an evidence-based approach



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INTRODUCTION

Bovine Tuberculosis (bTB), and especially the policies enacted to tackle it, can have serious emotional and financial impacts on farmers, their families and their communities, as well as suffering and death for huge numbers of cattle and badgers. Latest and previous data indicate that current approaches to dealing with this widespread disease are failing to bring it under control, let alone eradicate it, so a more effective, robust and evidence-based solution is urgently needed.

The RSPCA has a long history of engagement with governments, scientists and farmers to try and solve the issue of bTB. The wide-ranging knowledge, expertise and experience in both cattle farming and wildlife found within the RSPCA[1] means the organisation is well placed to analyse, understand and provide advice on issues relating to health, welfare and appropriate management within these two areas and to appreciate how they interact with each other.

In the 1970s, when licensed culling of badgers first started, the RSPCA sat on MAFF's consultative panel, which reviewed MAFF operations relating to bTB in badgers – including badger removal operations – until the panel was disbanded in 1997. Later, the RSPCA did not object to the Randomised Badger Culling Trial (RBCT) – it recognised the research was required, based on the evidence seen during its membership of the consultative panel. The RSPCA was also involved in the MAFF TB Forum from 1997 until it was disbanded and was a member of the Welsh Government TB Action Group responsible for informing policy for the control of bTB in Wales.

When the government in England announced in 2012 it was to proceed with pilot badger culls in two areas (west Somerset and Gloucestershire) the RSPCA objected and continues to do so. This position is based on the evidence generated and the recommendations made by the RBCT, the opinion of many international experts in the field of disease epidemiology[2], the Independent Expert Panel's (Munro 2014), and our own and others' (e.g. BVA Doherty 2018) concerns about the humaneness of the killing methods.

We are, of course, very mindful that others hold a different view. For example, some believe the badger cull is justified based on the view that there is a need to eradicate bTB in wildlife if it is to be controlled in cattle.

The aim of this document, therefore, is to set out why the RSPCA holds the position it does on the policy to control bTB in England. It explains why we believe the badger cull is a poor policy decision, which will not generate the reductions in bTB and the eventual eradication of the disease in cattle that everyone wishes to see. This is not intended to be a scientific review – others have already produced high quality reviews, e.g. Godfray et al. 2013 – but we provide references to support what we say.

Much of what follows in this document is based on the policy to control bTB as conducted in England. We recognise that the Welsh Government has a very different approach and support their steadfast approach to stricter testing and movement controls. That said, some of the suggestions made in this document could also be applied to bTB policy in Wales.

1. https://science.rspca.org.uk/sciencegroup/home
2. https://www.theguardian.com/uk-news/2015/sep/02/badger-cull-is-flawed-and-must-now-stop

1. FARMERS, ADVISORS AND OTHER INTERESTED PARTIES

The badger cull has been welcomed by some farming communities with enthusiasm. The cull zones have required groups of farmers to come together to set up companies and apply for culling licences. Although many farmers state they don't wish to cull badgers, they may perceive there is no other way to control the disease under the current policy (unlike certain other diseases).

The cull has provided a platform whereby farmers and landowners in a community can work together to tackle bTB (even if, in our opinion, it is through an ineffective method). This sense of community spirit and enthusiasm to get on top of a disease, the policy for which causes enormous financial and psychological stress on farming families, is an opportunity to implement a broader approach to manage and eradicate bTB, including cattle-focused measures.

The South West TB Farm Advisory Service (set up through the NFU, bringing together key stakeholders) provided a free service to farms to give advice on measures that could be adopted to reduce the risk of bTB breakdowns from 2010 to 2014. Many of the 1,159 farmers who benefited from farm visits said the advice they were given was extremely valuable to them. However, in 2009 (the year before the service launched) the number of farms in the south west with movement restrictions due to bTB was about 3,700 (7,449 farms in Great Britain, 52% of which were in the south west)[3].

TB Advisory Service

The reasons behind the low level of uptake of this free advice, as opposed to the badger cull, need to be explored and understood. The new and revised TB Advisory Service reports that the lowest level of uptake for their advisory services (funded by the state) is in the high risk areas, such as Devon and Cornwall. Farmer engagement with biosecurity advice and implementation has not been good.

In New Zealand, farmers are much more heavily involved in decisions relating to bTB control, for example, by being members of 'TB Free New Zealand', a legally recognised bTB control programme that is jointly funded by industry and government (60% and 40% respectively) as quoted in the Bovine TB Strategy Review commissioned by government and hereafter referred to as the *Godfray Review* (Godfray et al. 2018). If such groups could be created and used to determine local control policy, strategy and delivery, including compensation payments and incentives to engage, it could be a way of giving farmers more control and encouraging communities to hold their own to account.

Transferring the decision of compensation to individual farming communities will also incentivise them to develop a deeper understanding of methods of reducing the risk of contracting the disease other than badger culling. The ability to weigh up the pros and cons of different biosecurity measures and to determine how much effort an individual has made to evaluate his/her farm and farming practices, where their risks lie and ways to counteract them, would be necessary. It will also allow local farming communities to address some of the risky practices that they know are occurring but are powerless to prevent[5]. The *Godfray Review* also recommended transferring ownership of the disease to industry, as *"government payment for control implies government responsibility for the disease and the resulting lack of ownership of the disease by the industry can reduce the impetus to implement disease control measures"*.

Cooperatives proposal

We propose redefining the bTB cull companies as bTB control cooperatives with more responsibility to oversee local bTB control strategies and holding local members to account for bTB control on their farms. These cooperatives could have the responsibility of allocating funding to individuals for improvements on-farm and for knowledge exchange on bTB control strategies to the local communities, for example through discussion groups and on-farm workshops, so that bTB can be effectively controlled and managed by those who know the industry best. This would replace their role in organising and delivering the culling of badgers, which we feel should not be part of their remit, making them more effective in the successful management of the disease.

Withdrawal from the EU offers much more flexibility in how we manage bTB eradication as the UK will no longer be tied to European legislation regarding tests, vaccination and other EU regulations on bTB control. This provides an excellent opportunity to review the approach being taken and to move to an evidence-based, more effective and more welfare-friendly policy to the benefit of animals (cattle and badgers) and farmers alike. Any change in strategy will require a ground-up approach from farmers, with the implementation of some tried and tested social science techniques to encourage those who may be reluctant and/or disillusioned to re-engage with the effective control of this disease.

PROPOSAL 1: FORMATION OF BTB CONTROL COOPERATIVES

To restructure current cull companies into bTB control cooperatives and give them responsibility for funding bTB control such as allocating grants to those involved in the company for advice (financial and veterinary advice including potential use of further tests) and implementation of biosecurity and biocontainment measures on their farm.

3. N Cork, 2014, South West TB Farm Advisory Service. 4. https://www.fwi.co.uk/livestock/health-welfare/livestock-diseases/bovine-tb/dairy-farmer-in-tb-testing-vicious-cycle

2. FARM MANAGEMENT

bTB management plans

It is our opinion that there is far more to the spread of bTB than the badger. Cattle husbandry was identified as a possible cause for the persistence of bTB in west Cornwall many years ago (Richards 1972) but has never been fully investigated. Current bTB policy is based on the belief that the disease was largely eradicated from cattle by the 1980s and that the badger was largely responsible for the persistence of the disease in hotspot areas, and its subsequent spread. Many years later, it would now be impossible to assess the accuracy of this view. It may be that subsequent changes to policy, such as the relaxation of movement controls after the Area Eradication Scheme (AES), may have allowed the disease to return to areas where it had been eradicated.

Much of the conjecture on how the disease has returned so dramatically seems to have been based on the assumption that the **Single Intradermal Comparative Cervical Test**[5] **(SICCT)** results gave a true picture of disease status, and that as infected cattle had been removed, the source of infection must lie elsewhere (e.g (Phillips et al. 2003). This assumption persisted through much of the research conducted into bTB in the 1970s and 80s, despite limitations with the test being recognised in 1972 (Richards 1972). We therefore welcome the statement in the recent *Godfray Review*, which provides support to the view that the focus on the badger has prevented industry, and others, from doing more to tackle the disease.

We believe there is enough evidence to support the theory that there is a large, undetected reservoir of bTB in the cattle population (Christl A. Donnelly and Nouvellet 2013), and that this is increasing due in part to continued reliance on an inadequate testing regime, suboptimal cattle management and poor biosecurity.

The RSPCA pioneered the use of veterinary health and welfare plans (VHWPs) in our standards in 1997, which have now been adopted widely across most livestock sectors and include the measurement and management of many common diseases and health problems. We believe these should be working documents tailored to each individual farm, informing the daily decisions of the farm and being regularly reviewed and updated. We therefore support the proposal, brought forward by those such as Richard Sibley[6], that all cattle farmers wanting access to government funding should have a robust bTB management plan, as part of a wider VHWP. This should address biosecurity and biocontainment measures, as well as measures taken to improve the resilience of the cattle.

The presence of a robust plan, and compliance with the components of the plan, should be a precondition to receiving the benefits of state funded compensation should disease occur. Every farm, whatever its current status or geographical location, should have a bTB management plan, to either help prevent disease entering the herd, or eradicate it once it is in the herd.

5. Also called Single Comparative Intradermal Tuberculin Test (SCITT) and others.
6. For example "The future of controlling and eradicating TB from UK cattle herds" published in UK Vet Livestock May/June 2019 Vol 94 (3).
7. https://www.gov.uk/government/statistical-data-sets/tuberculosis-tb-in-cattle-in-great-britain

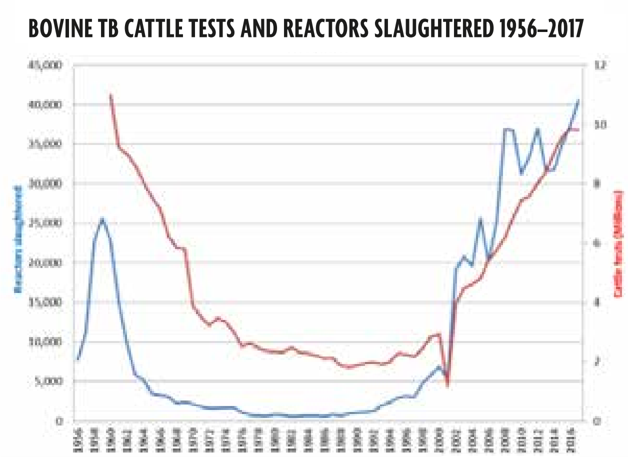
Cattle management

It is clear that the incidence of bTB in the UK cattle herd started to increase during the 1980s. A number of changes occurred during this time, which may have impacted this trend, notably:

- A marked relaxation of cattle testing and movement
- The badger culling policy in place from 1975 to 1998 may have contributed to spreading bTB as a result of 'perturbation' in the badger population, as was subsequently shown in the Randomised Badger Culling Trial (Bielby et al. 2014)
- The outbreak of FMD in 2001 also meant there was no testing for bTB for more than a year as the State Veterinary Service (SVS) was unable to deliver the testing required
- The 2001 outbreak of Foot and Mouth Disease (FMD) meant 750,000 cattle were slaughtered and farmers were forced to restock with cattle that often came from the south west, a traditional cattle breeding area that also had high bTB infection rates
- Increasing numbers of people involved in testing has led to increased variability in the reliability of the test.

There has also been a significant change in management practices in the cattle industry since the 1980s. Cattle breeding, production systems and growth in herd size encapsulated the philosophy at the time that focused on maximising production efficiency. These factors have never been adequately acknowledged, in our view, in terms of the potential impacts on the disease.

Figure 1: bTB cattle testing and slaughter data 1956–2017[7]
(Based on AHWBE 2012 and extrapolated to 2017)



Many current management practices may be affecting the resilience of the cattle to chronic diseases, such as bTB, which thrive when the host is immunosuppressed. Some of this immunosuppression may be due to chronic stress, endemic disease or the time in an animal's production cycle (for example during the transition period), and some may be due to breed related genetics. Other management practices result in a high risk of environmental contamination, e.g. slurry disposal, or a high risk of bringing in the disease, e.g. through cattle movements. The combination of high challenge and low resilience resulting from these situations can significantly increase the risk of disease spread.

Large herds

Herd sizes in England have increased from an average of 78 in 1996 to 148 in 2016[8]. Increased herd sizes have been linked to increased risk in transmission (Green and Cornell 2005) (Mill et al. 2012).

Increasing herd size increases the risk of disease spread, both through increasing the number of contacts and increasing the opportunities for an infectious animal to pass the disease on. Larger cattle herds create problems for disposal of larger volumes of slurry, making it more challenging to ensure housing design can keep up with gradually increasing animal numbers and adding difficulty to pasture management. In large dairy herds, cattle are often grouped according to production level, which may involve animals moving between different groups. This can result in increased stress, often in lower-ranking animals due to disturbance of the social hierarchy. This in turn may result in immunosuppression and animals being more likely to shed pathogens if they are infected, and possibly making them more susceptible to bTB infection.

To date no studies have been undertaken looking at the social hierarchy in bTB infected herds and whether certain animals are at increased risk of infection.

It is our belief that well-managed large herds, which address many of the issues listed above, are unlikely to face higher risk of bTB breakdown, but that once bTB is established, it will be harder to clear from the herd. Endemic disease in these larger herds may be difficult to detect and identify due to the low sensitivity of the SICCT and in such situations it is harder to have a whole herd removal policy. Research is lacking in this area and is needed to help establish which large herds are at higher risk and how their practices differ from lower risk herds.

This view was also put forward in the *Godfray Review 2018,* which stated: "Herd size is the single most common risk factor for bTB in Britain. However, it is probably not size, per se, that determines the greater susceptibility of larger herds, but practices that tend to be more associated with larger herds such as purchasing activity, farm size, number of premises and neighbouring herds."

An integral element contributing to the maintenance of a stable herd hierarchy is a clear communication structure between animals, which allows social interaction to occur without disrupting the overall hierarchy. If cattle housing facilities are not fit for purpose (as tends to be the case when herds expand more quickly than the housing facilities can accommodate), communication channels can then be disrupted. This can result in aggressive interactions taking place between animals. Examples of problems associated with inadequate housing facilities include poor ventilation, poor cow comfort, narrow passageways, inadequate lying and feeding space and poor slurry disposal. Such environments would provide the ideal conditions for the spread of bTB infection either via aerosol droplets or environmental contamination with faeces.

Internal movements

With modern management systems in larger dairy herds, it is increasingly the case that dairy replacements are reared elsewhere and then introduced to the herd shortly before calving. Although some of these will be on separate land holdings and subject to pre-movement testing in HRAs, some will be within the same land holding on large farms, despite being geographically relatively separate.

Under current rules, remotely reared animals can be introduced to the milking herd without any prior testing or recording of the movement as long as they have been kept within a 10-mile radius of the main farm area. The impact of these short but frequent movements on bTB transmission is currently not known and needs researching.

8. https://dairy.ahdb.org.uk/resources-library/market-information/farming-data/average-herd-size/#.WvsEAfkvyUk

This was raised in the *Godfray Review*: "A little over 1.7 million cattle were moved within and between different risk areas in England in 2016. Movements between non-contiguous parts of a single farm business, which may be some distance apart, are not included in this figure. This number of movements has remained broadly similar over time and includes substantial numbers moving from higher to lower-risk areas. Even if a small fraction of the animals that are in transit is infected, the very large number of movements suggests this could be a potentially important source of new infections."

If a herd falls under a bTB outbreak, cattle movement restrictions mean the farm may have to carry extra stock, which could put pressure on feed and housing stocks, increasing stocking density, mixing of unfamiliar animals and disrupting the social hierarchy. All these issues in a system only just coping could put the cattle under stress, which in turn could compromise the immune system. Cattle infected with bTB can spread the disease very efficiently within the herd via direct aerosol (Skuce, Allen, and McDowell 2011) through saliva or faeces contaminating the communal feeding and drinking areas.

Cattle breeding

The predominant milk cow in this country has changed over the years with the introduction of Holstein bloodlines from the USA. Dairy cows are now more productive in terms of volume of milk, but where farmers have not managed to meet the increasing needs of these highly productive cows there has been a negative effect on their health and welfare due to the ever increasing demands of these higher production levels (Oltenacu and Broom 2010).

The modern dairy cow is probably the hardest-working farm animal and possibly the most vulnerable. There is a particularly vulnerable period in the cow's physiological cycle that makes her susceptible to metabolic and infectious disease, notably, the pre- and post-partum period where the cow moves from pregnancy to high milk production resulting in major nutritional, hormonal and metabolic stresses that have to be carefully managed.

During this time cows in negative energy balance can lose weight and become more susceptible to disease (Mallard et al. 1998, Aleri et al. 2016). Immunosuppression at this time can not only increase the susceptibility to infections, but may also activate subclinical or latent infections. Thus, if an animal is latently infected with bTB there is a potential that the latent infection becomes active and shedding occurs i.e. an infected animal becomes infectious. It is also possible that uninfected animals may be more susceptible to disease during such a time, but this is less well established.

On that basis, we believe transition cows should be kept separately and given specific care. They should not be put into situations where there is likely to be an increased threat of bTB infection, such as placing them in an intensive strip-grazing system where they may eat contaminated pasture from the previous day's grazing and where access to forage is competitive.

Endemic disease

There are several endemic diseases in the cattle population also known to have an immunosuppressive effect, such as Bovine Viral Diarrhoea (BVD virus) and Johne's Disease (*Mycobacterium avium subsp. paratuberculosis*), among others. Many herds have robust health plans to eliminate these diseases and there are successful industry initiatives in place, such as BVD Free and Action Johnes.

The presence of some of these endemic diseases in a herd is known to reduce the already poor sensitivity of the SICCT (de la Rua Domenech 2006) through their effect on the immunological activity required to make the test sensitive.

Accurate assessment of whether farms with low levels of endemic disease are less likely to be infected with bTB is clearly necessary in order to accurately gauge what effect these diseases are having on the government's aim of eliminating bTB from the national herd. Some of these diseases only became widespread in more recent years. BVD, for example, was found in a more virulent form in the 1980s and thus may have a role to play in the expansion of bTB infection too.

We believe there needs to be a complete re-evaluation of cattle husbandry methods and associated risk of bTB. Although some work has been done (see 'Introduction' to Reilly and Courtenay 2007), we do not believe it has been thorough or exhaustive enough. Nor has it led to changes in management in the industry that would result in positive effects in the UK cattle herd over and above simply improving bTB control.

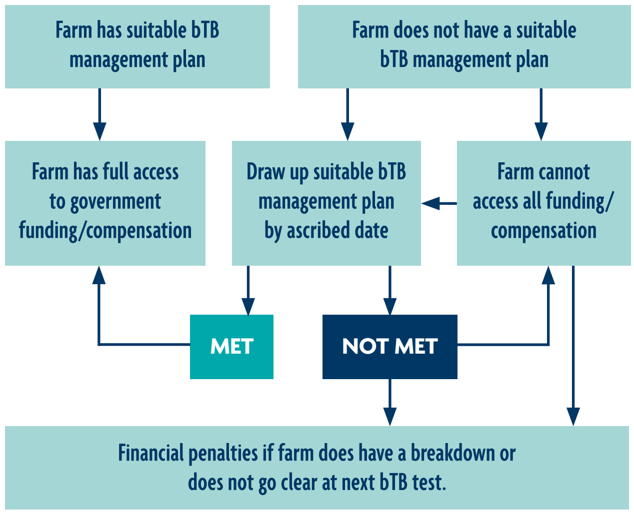
Biosecurity

Currently, all holdings participating in a badger cull are required to be implementing biosecurity measures (Defra 2018b), defined as being reasonable, proportionate and appropriate with regards to the Bovine TB Five-Point Plan as laid out on Defra's TB hub.

This is monitored and implemented by Natural England and there is a strong case for believing the monitoring is not sufficient, the biosecurity measures being taken are not good enough and there is a lack of follow-up on farms that were rated "poor" when monitored. (Dale 2017). For Approved Finishing Units (AFUs) there are terms and conditions regarding biosecurity that must be met.

The most recent proposal for Approved Finishing Units: Extended (AFUEs) had the most comprehensive set of biosecurity measures within the terms and conditions to date. We would be keen to see these detailed biosecurity measures extended to premises which hold cattle and undertake badger culling.

We believe compulsory implementation of effective biosecurity measures on **all** farms, appropriate to their bTB risk, is necessary, with Veterinary Improvement Notices (VINs) given if not implemented by a stated date. The potential for compensation penalties if animals aren't found to be 'clear' at the next test after the date decided upon, or activation of a transparent process resulting in revoking the cull licence for any involved in badger culling, could incentivise implementation.



Slurry

The rise in herd size and increased housing of cattle, and changes in housing and husbandry systems from deep litter yards to free stall and cubicle housing has increased the volumes of slurry produced on many cattle farms. Its disposal is a major problem for some livestock farmers.

The possibility of environmental contamination by bTB through slurry has been known about since the 1930s (Williams and Hoy 1930) and given the increased evidence that badgers prefer to avoid direct contact with cattle, this route of infection – from cattle to badgers via cattle faeces – may well have greater significance than previously thought (Woodroffe et al. 2016) (Mullen et al. 2013). Slurry can also be a breeding ground for invertebrates that are eaten by badgers and there is evidence these may become contaminated (Barbier et al. 2016).

If there is an undetected reservoir of bTB in the cattle herd, then a large potential risk factor for transmission of bTB could be the storage and spreading of contaminated slurry (Reilly and Courtenay 2007) and recent work conducted on a farm in Devon supports this[9]. Risks associated with slurry spreading include:

- The creation of aerosols that can carry for hundreds of metres (Hahesy et al. 1996)
- The potential to be washed off land into watercourses
- Pastures being grazed immediately (or shortly) after dressing with slurry (Richards 1972) despite recommendations as long ago as 1946 not to spread on grazing pastures
- Slurry tankers moving from farm to farm without being washed down between properties.

If these are still unaddressed, slurry spreading could be a significant source of infection. Disinfection of slurry before spreading is mandatory in Germany (Phillips et al. 2001) and the TB hub has advice on the topic, but the extent to which it is being implemented on-farm is unknown.

We recommend a herd's bTB management plan must have a robust slurry management and dirty water management section following best practice, such as:

- Storage of slurry/dirty water for six months prior to spreading
- Spreading slurry/dirty water on arable land not intended for grazing for at least six months
- Spreading slurry/dirty water using methods which limit aerosol formation, e.g. injection or immediate ploughing
- Treating slurry prior to spreading.

Biocontainment

Measures have already been taken by Defra to improve biosecurity, but much more can still be achieved in terms of limiting contact *within* a herd between potentially infected cattle and the rest of the herd (biocontainment).

Furthermore, there needs to be better understanding of how the disease can move through the herd by direct or indirect contacts, given the growing evidence that animals that appear to test 'negative' may in fact be infected and infectious (refer to the Testing section, page 9, for more information). A survey of farming communities in the south west stated only 18% had alternative holdings that could be used to quarantine bTB positive animals (Farm Crisis Network 2009) which indicates many farms lack facilities to do this adequately.

The role of infected cattle that are shedding organisms in their faeces in both direct and indirect contamination of the environment is likely to be far more significant than that of infected wildlife such as badgers.

Infection in the environment coming from cattle (rather than wildlife) has not yet been well researched, but it is reasonable to suggest that infected animals in the close confines of a barn are likely to infect other animals both through direct contact and through contamination of the environment, especially when the disease 'shedders' are stressed.

There is some evidence that stress can enhance the level and duration of pathogen shedding in animals subclinically infected with disease, thereby enhancing their infectivity (Scientific Committee on Animal Health and Animal Welfare 2002) (Rostagno 2009). Moreover, this environmental contamination could survive for a long time after the removal of the infected animal, for example pasture contamination has been shown to last for weeks when protected from sunlight (Barbier et al. 2017). It is clearly important to know the level of environmental contamination and how long the bTB organisms survive in the environment in a form capable of infecting cattle.

How pasture is managed is also important. Although an animal that tests positive may be removed from the herd, the herd itself may well be returned to pasture where that infected animal was grazing just weeks, or even the day, before and this has been shown to be a source of transmission (Phillips et al. 2003). The TB hub makes no mention of resting (or quarantine) periods, but does have a factsheet[10] acknowledging that bacilli from manure can survive on pasture for up to two months in summer.

9. Interview with Dick Sibley, *Farming Today*, BBC, 12 September 2018
10. http://www.tbhub.co.uk/wp-content/uploads/2018/01/AR-factsheet-faeces-and-slurry-120118.pdf

Strip grazing, often deployed as a result of herd size increasing relative to the geographical size of the farm, may also be a factor in rising bTB levels. Strip grazing is also often used as an early season grazing technique, irrespective of herd size, to try and utilise the grass more efficiently. Such systems cause the land to be grazed very hard and because some animals are so severely restricted within an area as to what they can eat, this could result in ingestion of contaminated material of badger or cattle origin. Cattle will avoid pasture contaminated with badger faeces or urine, but only if they have a choice (Benham and Broom 1991). If they have no other grass to eat, they will eat contaminated pasture.

Also, research shows that low ranking animals in the herd, which may be more likely to be immunosuppressed, are more likely to eat contaminated pasture first (Hutchings and Harris 1997). Similarly, transition animals are highly likely to be vulnerable under these circumstances, given they are the animals under the most physiological stress within the dairy herd (see Cattle Breeding page 7).

Reduced farm size relative to herd size[11] also means rest times for pastures are likely to be reduced to the minimum necessary for the land to recover. Mycobacteria, which have been shown to survive many months on pasture (Young, Gormley, and Wellington 2004), could still be present when the herd comes to graze that section again after an infected animal has previously grazed an area.

DAERA's review of cattle-cattle transmission (Skuce, Allen, and McDowell 2011) found that bTB reactors tended to appear in clusters within herds – some herds consistently having many, others having none. This is also found in the High Risk Area of England where it is well known that some farms have remained bTB free for years, despite being surrounded by infected premises. The reasons for this need to be investigated and established. Practices on these bTB-clear farms relative to those that have repeated breakdowns should be scrutinised and compared to identify and assess the significance of any differences.

Biocontainment involves the assessment, quantification and management of every possible potential risk of transmission from infectious cattle to susceptible ones, either directly or indirectly. This may entail managing 'high-risk' animals differently, similar to the Johne's Action Plan, with animals ranked according to risk of infection. Infected and infectious animals that have not been identified by the routine SICCT tests may be detected by more sensitive tests, and need to be managed accordingly to prevent the spread of disease.

Testing

A more detailed section on the current government testing policy can be found on page 12. This section focuses on what options are available to farmers under the current government policy.

Cattle producers are not able to choose which test is used for statutory surveillance. There is, however, the possibility to apply, in conjunction with the farm's veterinary surgeon, for permission to carry out further testing. There has yet to be a test developed that combines both high specificity and high sensitivity and so ideally multiple tests would be used in parallel.

There are alternative tests available to detect *M. bovis* infection in cows such as ELISA, Enferplex, qPCR and Actiphage (a new, and as yet unvalidated test), which can be used as part of a wider disease management programme in a herd that is under bTB restrictions (Sibley 2018). These tests can help to identify cattle that may be latently infected or anergic[12] and, if used in conjunction with PCR tests on saliva and faeces, can determine if cattle are not only infected, but also infectious. As these tests are not part of the 'official' bTB testing regime, there is as yet no compulsory slaughter and compensation scheme for animals that test positive using these novel alternative tests, allowing appropriate management without severe loss of animals and the consequent effects on finances.

There is some concern that genetic factors may be affecting the sensitivity of the SICCT test. The possibility of selecting for bTB disease resistance has been only a relatively recent addition to UK genetic indices (TB Advantage, 2016). Since this is based on SICCT results, it has not been definitively established yet whether this is true resistance to bTB or anergy.

This was highlighted in the *Godfray Review*: "There is a risk that the index may in part reflect the ability to avoid reacting to the skin test, rather than genuine resistance to infection. Further research on the biological mechanism underlying resistance and the role of genes identified by the genetic analysis will be important in excluding this possibility."

There is evidence of a genetic predisposition for some cattle to give a negative reaction to the SICCT (Amos et al. 2013) and that this effect would be amplified from generation to generation, given that it is those cattle that react negatively to the test that remain in the herd to breed. It is unclear to what extent the industry use the TB Advantage index (a genetic index selecting for bTB disease resistance in cattle) in breeding decisions as yet. However, it is also accepted that susceptibility to the disease is linked to genetic traits in cattle (Gallagher and Clifton-Hadley 2000), and so any accurate tool that farmers can use to select cattle with less susceptibility (i.e. disease resistance) would be extremely useful.

PROPOSAL 2: STRENGTHENING BIOSECURITY, BIOCONTAINMENT AND COW RESILIENCE

Encourage changes in farm management to improve biosecurity and biocontainment and to generate more resilient animals. This would include a bTB management plan tailored to each farm, taking into account each farm's financial situation and bTB risk level.

Assurance schemes to come together to produce aligned bTB control plans for scheme members, with standards including minimum biosecurity requirements to specifically prevent bTB.

11. Average UK dairy herd size (cow numbers) 82 in 2000, to 121 in 2010 (48% increase) – data from AHDB dairy farming data https://dairy.ahdb.org.uk/resources-library/market-information/farming-data/average-herd-size/#.W5JhfNQrLDc, Average UK farm size (in ha) 79.5 in 2000, to 84 in 2010 (6% increase) – data from Agricultural Census in the United Kingdom. Figures as up to date as possible. Limited by agricultural census frequency.
12. Anergy is a term in immunobiology that describes a lack of reaction by the body's defence mechanisms to foreign substances.

3. FUNDING FOR bTB CONTROL

The cost of enacting the current government policy is high, with more than £8,000 spent per outbreak (Defra 2018). Three-quarters of this expense is in compensating farmers for the large numbers of cattle slaughtered as part of this policy. The cost to an individual farmer per outbreak is approximately £10,000, and likely higher when loss of genetics, milk, etc. are also considered. Despite the large amount of money spent, the compensation scheme is inequitable and often unfair – the system creates severe financial hardship in some affected herds, whilst discouraging prevention and effective control in others.

	Government	Farmers	Total
Testing costs	2,127	2,611	4,738
Slaughter costs	6,517	6,998	13,515
Restrictions and isolation costs	0	493	493
Administration costs	285	0	285
TOTAL COSTS	8,929	10,103	19,032

Estimated average cost of a confirmed new bTB breakdown in the High Risk Area of England (£, 2018 prices)

Table taken from Defra's publication *Badger control policy: Value for money analysis 2018*

The RSPCA believes, therefore, that the current approach to compensation is not conducive to eradicating the disease as farmers have less incentive to do so, particularly when their breakdowns are sporadic. We agree with the *Godfray Review* that more analysis should be conducted on risk based trading and that compensation rules should be overhauled. Rather than farmers being compensated for having bTB, they should be given incentives and rewarded for prevention and effective eradication.

It is important farmers take, and are given the opportunities to take, more 'ownership' of the disease, and this could be, as a first step, through developing robust bTB management plans with their private vet prior to any changes requiring significant financial input. However, we also believe that the government needs to target its funding into the most effective channels.

We believe that alongside funding free advice services, such as the TBAS, or funding for improved handling facilities or incorporating biocontainment measures into on-farm management, it is vital that producers receive financial advice. Many of the proposed changes have financial implications and changing the testing regime could result in the loss of many more cattle as the undetected reservoir we believe exists in the cattle herd is gradually identified, as is being seen in Wales at the moment (Defra's latest quarterly overview, June 2019).

We are convinced that, although this has significant financial implications in the short term, in the longer term the removal of these animals will have a real effect in reducing bTB in the cattle population and will have a smaller net cost. In Wales' bTB eradication programme the targeted chronic farms receive financial advice as part of the package, as it is acknowledged that bTB costs go beyond the test itself and the possible loss of cattle, but include the loss of productivity of that animal – her milk, her calf, her genetics – and producers will need a long-term financial business plan in place to reassure them while they get bTB under control on their farm.

There are other sources of funding, especially for badger vaccination through the government's Badger Edge Vaccination Scheme (BEVS), however the uptake of this funding, like several government funded initiatives, has not been as good as hoped. Considering that a recent study looking into costs of culling vs vaccination per sq km per year showed that costs of vaccination (especially where volunteer led) was much less expensive to farmers and government (culling currently costing £2,247 vs vaccination costing £592 (Woodroffe 2018) it is surprising farmers do not take more advantage of these schemes. Where culling is taking place it wouldn't be a case of producers increasing their financial input, but redirecting it more appropriately.

Ultimately, however, recent Defra data indicates: *"the average cost to farmers to improve biosecurity is about £4,000. Considering the average cost of dealing with a bTB herd breakdown in GB (about £27,000), these measures would appear to be a cost-effective way of attempting to reduce potential bTB transmission between species."* (Allen et al. 2011) and so we see no barrier to the simpler and more immediate changes being made as soon as it is practical to do so.

PROPOSAL 3: FUNDING OF CONTROL MEASURES

Funding of the improvements in biosecurity and biocontainment, provision of financial and specialist veterinary advice and further testing should come from a variety of sources, some government and some industry (as is currently the case) – for example from the bTB control cooperatives, via milk premiums (where applicable) or assurance schemes.

4. THE ROLE OF VETS IN PROACTIVE MANAGEMENT

Both government vets and private vets have important roles to play in the control of bTB. In recent years private vets have largely had a role in carrying out bTB testing on their clients farms, but proactive planning and discussion about how to tackle bTB on-farm has rarely been carried out to the same extent as it is with other herd health issues.

A study in 2009 showed that farmers felt they had no control about their bTB status and that advice from both government and their own vets varied, some feeling they'd received lots of helpful advice, others feeling dissatisfied (Farm Crisis Network 2009). Since then work has been done through the TB hub and TBAS to provide clear, consistent information but we think there is a need for more specific, tailored veterinary advice on controlling the disease within the herd.

We are reassured to see TBAS arranging bTB evening meetings and the TBAS inaugural conference in June 2019. We hope producers and vets take such opportunities to better appreciate how much they can affect this disease through measures taken on-farm and that as a result, they will feel motivated to start more in-depth conversations with one another, as they do with other diseases such as BVD. Specifically trained veterinary advisors make up part of the National Action Johne's strategy and this could be something considered by government for bTB, either using their own vets or providing training to private vets to create a network of specifically trained TB veterinary advisors.

Increased numbers of testers also has an impact on the SICCT test. Evidence suggests variability in the SICCT test increases due to different individuals carrying out the test and varying quality of handling facilities provided for testing (Enticott 2014).

Further work carried out in Ireland suggests that most individuals carried out testing to a suitable standard, but a minority of individuals consistently carried out the test poorly (Duignan et al. 2012). Ireland has developed a quality control programme focusing on the critical control points to ensure testers are achieving a suitable standard.

The variability between testers and handling facilities is not new, and would have been present in the 1960s and 70s. However, combined with the increased herd sizes seen today and factors such as more fractious animals due to the increased use of continental breeds (making the testing procedure more difficult), it is not unreasonable to think that these inter-tester variability factors play a greater role in the poor sensitivity of the SICCT now, and hence in maintaining a reservoir of infected animals in a herd. Furthermore, the proposed introduction of lay testers adds another variable that needs to be carefully managed.

Currently, access to further testing (such as PCR, ELISA, Enferplex and Actiphage testing) is tightly controlled and the process whereby a vet can get permission to carry out such tests is complex and time-consuming. In today's average farm practice few vets have the time to go through such a process and, due to the legalities, are in danger of inadvertently breaking the law if they make a mistake. It is vital that the government facilitates the private vet's access to these tests. We recommend a thorough review, undertaken with practising private vets. The aim should be to simplify the process where possible, culminating in clear guidelines on the TB hub which can be followed to give private vets confidence they can complete the process in line with the law – and quickly, so it is easily manageable within their high workload.

PROPOSAL 4: STRENGTHENING AND SUPPORTING THE ROLE OF VETS

Private vets and government vets to take a greater role in proactively managing the disease through discussions with clients, development of farm-specific herd health plans, knowledge exchange and applying for licences so as to be able to offer clients the ability to carry out further testing.

Government to facilitate applications by private vets to carry out further testing (i.e. using other tests alongside the SICCT) through developing clear guidelines published on the TB hub after reviewing and simplifying the process with input from private vets.

5. TESTING – IS THE CURRENT REGIME GOOD ENOUGH?

The RSPCA believes that transmission of the disease between cattle is a far more significant risk than badger to cattle transmission and that there is an undetected reservoir of the disease in cattle the current testing regime is not – and is not capable of – dealing with. We believe statements that are often applied to badgers, such as "*despite the absence of lesions in the majority of infected animals, badgers with any state of infection may pose a risk of transmission to susceptible hosts where there is close and frequent contact*" (Gormley and Corner 2017) are likely to apply to cattle as well, but the current policy does not appear to take this into consideration.

Currently, cattle are tested for bTB using the SICCT[5], a test which has been used for many years in the attempt to eradicate bTB. Two different types of tuberculin protein are injected (avian and bovine), one above the other and then 72 hours later the reactions (if present) are measured and compared. Reactors to this test are defined as bTB positive in accordance with APHA guidance using two levels of interpretation – 'standard' and 'severe'. Reactors must be removed from the herd (via slaughter). Those with intermediate reactions are defined as 'inconclusive' and must be retested in 60 days, and those with 'no reaction' are determined to be clear (they may have reactions to the injections but their differences in size are within the permitted limits, which vary depending on the interpretation of the test). The Gamma Interferon (IFN-γ) test uses the same principles to detect sensitised cells in the blood of cattle, but is laboratory based rather than using the cow as an indicator.

It should be noted that the SICCT test is only used in the UK, Republic of Ireland and Portugal; the rest of Europe uses the Single Intradermal Cervical Test (SICT or SIT) test which has a lower specificity but a higher sensitivity (Godfray et al. 2018) and New Zealand uses the Caudal Fold Test (CFT). Any such diagnostic test is limited by how **sensitive** it is and how **specific** it is. Simply put, the more sensitive a test is, the more likely it is to correctly identify all infected animals. So a test that is 90% sensitive should correctly identify nine out of 10 infected animals, but is likely to miss one in 10 infected animals (false negatives). There have been various studies to assess the sensitivity of the SICCT and the results vary from 81% (Goodchild et al. 2015) to 50% (that is, one in two infected animals tested may come back with a 'negative' result despite having the disease) in a meta-analysis authored by the Animal and Plant Health Agency (Nuñez-Garcia et al. 2017). This discrepancy is corroborated by the *Godfray Review*: "There is some evidence that the sensitivity of the SICCT under operational field conditions is lower than that estimated in formal trials."

Conversely, the specificity describes how accurate the test is in ruling in the disease, so if the specificity is 99% then 99 animals out of 100 identified as 'positive' by the test do have the disease but one animal in that 100 will be identified as 'positive', but is in fact negative (a 'false positive'). False positives are frustrating for farmers as they result in what may be healthy cattle being removed for slaughter. The SICCT has a high specificity (99.98% (Goodchild et al. 2015)), so out of 10,000 uninfected animals tested, only two will have a 'positive' test result despite not having the disease).

This test continues to be the one officially sanctioned by government, which continues to maintain that average sensitivity of the test is 80%, but we feel the most recent research should force government to reconsider its position on this outdated test. Any test has to balance sensitivity with specificity. As stated above, the SICCT has a high specificity, which is good, as it means fewer false positives. However, if use of this low sensitivity test results in

a large number of bTB positive animals testing negative, then this is of great concern and may have been responsible for a significant number of infected animals being 'missed' over many years. It is reasonable to suggest that, to be able to control the disease with any degree of efficacy, any test should at least be able to identify cattle that are both infected and infectious. To date, this has not been achieved.

Testing of cattle was made mandatory in 1950 and the testing and removal of positive cattle led to a dramatic decline in incidence of bTB so that by 1965 it was reduced to a level of 0.06% (Proud 2006). However small pockets of infection persisted, such as in the Penwith area of Cornwall. A report produced for MAFF identified a number of factors that may have been responsible for this, such as herd size, pasture management, slurry management and building quality (Richards 1972). This is the last report we are aware of that focuses on cattle as the primary source of bTB transmission.

The SICCT test clearly served its purpose in the 1960s and 70s, but other tests are now available that may be more appropriate. For example, the SICCT test is most efficient when used on a herd basis, to assess the disease status of the herd, but as outlined above, its poor sensitivity means it cannot accurately determine the infection status of a single animal, rendering it unsuitable for use as a pre or post movement test.

This point has been made by the Irish Department of Agriculture, Food and the Marine in papers to inform their TB Forum, launched last year: "The clear message is that, while most infected cattle will be detected by the test, not all will, and this is the reason why the test is interpreted at a herd level; one should not assume that simply by removing the reactors, no infected cattle remain in the herd." (DAFM (Department of Agriculture, Food and Marine) 2018)

The SICCT test is also hampered by the variability derived from different individuals carrying out the test and varying quality of handling facilities provided to those carrying out the test (Enticott 2014). As outlined on page 11, this longstanding variability factor is often combined with other more recently introduced challenges (e.g. greater herd sizes), so it is not unreasonable to consider it now plays an even greater role than previously in contributing to the poor sensitivity of the SICCT and maintaining a reservoir of infected animals in a herd.

Other tests, such as **Gamma Interferon (IFN-γ), Faecal PCR, ELISA and Enferplex**, are available and IFN-γ has been used as part of the bTB control policy in other countries (e.g. New Zealand) for many years. However, there are various issues related to the wider use of these tests. It is highly likely that the use of such tests will increase the numbers of cattle that need to be killed. We do understand why some in the farming community are reluctant to adopt new tests, as they are worried that some of these animals may be false positives (especially when IFN-γ is used, due to its slightly lower specificity of 98% (Nuñez-Garcia et al. 2017)). However, parallel testing, such as used in New Zealand, can help to identify and remove other animals that are genuinely infected and potentially infectious, but which might not have been identified by the less sensitive SICCT.

An example of how effective the IFN-γ test can be in detecting previously negative or inconclusive reactors can be seen in Cumbria (APHA 2018a). Cumbria became a bTB hotspot after infected cattle were brought in undetected in Northern Ireland. IFN-γ was widely used and often found more reactors than the skin test. Prior to badger culling becoming established the bTB outbreak in cattle reduced markedly with 28 skin test reactors and 87 IFN-γ reactors in 2018, compared with 104 and 134 respectively in 2016. While this test has a higher sensitivity than SICCT (i.e. leaves fewer infected animals undetected in the herd), it is still only between 67% and 78% sensitive (Nuñez-Garcia et al. 2017).

Another additional test, **Actiphage**, is as yet unvalidated but this test, uniquely among the others, detects the presence of viable *M.bovis* organisms within blood cells taken from cattle. This allows the identification of infected animals, which may at a later date become 'shedders'. These animals can be detected and removed, possibly before shedding the bTB bacterium and potentially infecting other animals or contaminating the environment. We believe this test needs validating as soon as possible to help those with persistent infection or chronic repeated breakdowns to remove or isolate animals harbouring the disease.

Confirmation of bTB infection is usually based on post-mortem examination, through inspections of carcasses for lesions at slaughter, and through culture of tissue samples (Godfray et al. 2018). Many farmers are upset when they receive the results of these tests if animals are thought to be false positives, i.e. animals that were positive on test, but negative on inspection and culture (Farm Crisis Network 2009). It should be noted, however, there is recent evidence that raises questions about the effectiveness of inspection for lesions if the cattle have become infected by ingesting the bacteria through contaminated food (Serrano et al. 2018). This may help to explain why some positive cattle do not have typical lesions and so may be seen as false positives. The categorisation of VL (visible lesions) and NVL (no visible lesions) needs to be reviewed, as it causes confusion and has no scientific basis.

We believe it is reasonable to conclude that the existing testing approach is flawed. Additional tests are necessary and should be used in conjunction with each other to reduce the numbers of false positives and false negatives and hence to make a meaningful contribution to bringing bTB in cattle under control.

PROPOSAL 5: IMPROVING THE APPROACH TO AND ACCURACY OF TESTING

Government to address the factors which affect the sensitivity of the SICCT while it continues to be the main test used for identifying infected animals.

To move away from the SICCT as the main herd screening test to an alternative test with equal specificity but higher sensitivity or move to using a combination of tests (parallel testing) to maximise both sensitivity and specificity, particularly in persistent and recurrent infected herds.

6. MESSAGING – the need for accuracy and appropriate emphasis

Biosecurity advice is available for farmers through the TB hub and the TB Advisory Service[13], which aim to support their efforts to prevent their herd from coming down with bTB. The advice is predominantly aimed at preventing badgers and cattle mixing and is based on research conducted between 2005 to 2009. This assessed whether it is possible to reduce contact between badgers and cattle within farmyard buildings, and concluded that badgers were not able to access the building if the exclusion measures suggested were used, with a success rate of 100% (Judge et al. 2011).

However, in our view, there is not enough emphasis being placed on information provided about biocontainment, i.e. preventing infected or high risk cattle mixing with non-infected cattle on-farm, nor about managing the possible sources of environmental contamination, such as slurry. Furthermore, a link to information regarding badger vaccination has only recently been made available on the government page listing methods of controlling the risk of bTB from badgers[14] despite government having funding available for those wishing to undertake badger vaccination schemes.

Recent announcements[15], stating that the two pilot badger culls in Somerset and Gloucestershire have succeeded in reducing bTB in cattle, are also open to challenge. The evidence (APHA 2018b) indicates that incidences in bTB have declined dramatically, but the starting point used for measuring this decline was three years prior to the culls starting, indicating that bTB was already declining before any badgers were shot. The data then shows another drop in incidence in the fourth year of the culls, but it does not show a reduction in *prevalence*. This means that although new cases may have reduced, the level of disease in the cattle population has not, indicating the disease is still circulating in the cattle population at the end of the four-year cull. The conclusion of the report also clearly states *"these data alone cannot demonstrate whether the badger control policy is effective in reducing bovine TB in cattle"*, yet upon making this preliminary data public, statements were made claiming these results did just that. Similar reports, such as the Brunton Report (Brunton et al. 2017) contained many caveats in the results section and concluded *"it would be unwise to use the findings of this analysis to develop generalisable inferences about the effectiveness of the policy at present".*

Similarly, comments made by the former Defra Secretary of State Michael Gove at the recent NFU conference[16] stating *"the independent Godfray report confirmed that targeted culling will continue to have an important part to play in tackling this dreadful disease – alongside work to further improve biosecurity"* are open to challenge. The *Godfray Review*, in our view, gave no such conclusion but weighed up the pros and cons of both culling and alternatives. The *Godfray Review* stated: *"Whether culling in addition to current cattle controls can reverse the increasing trend in bTB in England is not known, but it does represent an important option to help in controlling the disease."* However, the review also said *"moving from lethal to non-lethal control of the disease in badgers is highly desirable",* and described the benefits of culling as *"real but circumscribed".* We believe the form of words used by Michael Gove is misleading and does not properly represent the Review's findings and conclusions, which is of particular concern given his political status and hence the likely and understandable reluctance of many to challenge his view. Some may interpret his comments as saying that the *Godfray Review* affirmed the government's policy to cull – but with no reference to the serious challenges the report raised against culling.

We are glad to see improvements in the biosecurity measures required for AFUEs (see page 7). However, if these are not extended to those participating in badger culling it sends the message that, despite the acknowledged risk of bTB infection to wildlife from cattle[17], the government and those involved in the cull are willing to continue a programme of culling, whilst not protecting the wild species from reinfection through farming practices and poor detection of infected cattle. This in turn perpetuates the cull indefinitely and propagates the idea that a badger cull alone is capable of bringing bTB in cattle under control.

As outlined in several sections above, the available evidence from a variety of robust sources – including, in some cases, the government's own advisory bodies – does not support this.

The perpetuation of poorly evidenced misconceptions from all parties is also something we see as a significant barrier to progress. For example, there is plenty of evidence that reactors to the SICCT that have no visible lesions (NVL) are still infected, but it is often inferred that NVL reactors are false positives. Since the SICCT specificity has repeatedly been found to be very high (99.9% – to illustrate this, when 1,000 animals are found to be positive, only one will be a false positive) it is highly unlikely NVL reactors are false positives, even more so when there is more than one in a herd. Furthermore, recent evidence shows the route of infection is important, with cattle infected by ingesting bTB still reacting positively to to the skin test, but showing no typical lesions on post mortem because the lesions were in the abdomen rather than in the thorax and were slower to develop too (Serrano et al. 2018). Sector influencers who work closely with the farming community and represent a trusted platform from which to correct these misconceptions have a responsibility to do so.

PROPOSAL 6: ENSURING EVIDENCE-BASED COMMUNICATION AND ADVICE

That all stakeholders be aware of the importance of giving accurate advice and of correctly prioritising prevention and control measures with particular emphasis on managing environmental risks rather than wildlife.

The Biosecurity Five Point Plan should have cattle measures first, rather than wildlife ones, since cattle-cattle transmission is the greatest cause of bTB incidence on farm;

Government statements indicating badger culls are achieving results should be evidence-based and informed by properly analysed data and not be based on preliminary data as this cannot confirm such correlations.

13. http://www.tbas.org.uk/
14. https://www.gov.uk/government/collections/bovine-tb-controlling-the-risk-of-bovine-tb-from-badgers
15. https://www.gov.uk/government/news/new-data-shows-drop-in-bovine-tb-as-further-measures-to-fight-disease-unveiled
16. https://www.gov.uk/government/speeches/a-world-to-win
17. acknowledged to the extent that they are willing to require AFUEs to meet comprehensive biosecurity measures and have admitted that in Cumbria badgers were infected from a cattle source

7. IS THERE A NEED TO ADDRESS THE DISEASE IN BADGERS?

The assumption driving the culling of badgers is that this wildlife reservoir plays a significant part in spreading bTB to cattle and that this can be eliminated by eliminating the badger. The first badger identified with the disease was found in the UK in 1971 (Krebs 1997), although suspicions were present beforehand, and there has been plenty of evidence since showing some badgers do have the disease.

The RSPCA accepts badgers are likely to play a small role in this disease of cattle. However, the extent of their role is still largely unknown – although available information indicates it is small. Data from the RBCT indicated between 15% and 17% of badgers are infected, but this is not consistent across the population as a whole (Bourne 2007). Recent data collected in separate studies in 2018 indicated only 5% of badgers culled in cull zones were positive for the disease (46 out of 994) (Defra 2018a), while an analysis of road casualty badgers from the Edge Area indicated it was as high as 21% (Sandoval Barron et al. 2018). The latest data from Wales shows only 9% of badgers removed from chronically infected farms were found to have bTB on post-mortem[19], compared with 12% during the 2005–2006 *Badgers found dead* survey, which covered the whole of Wales.

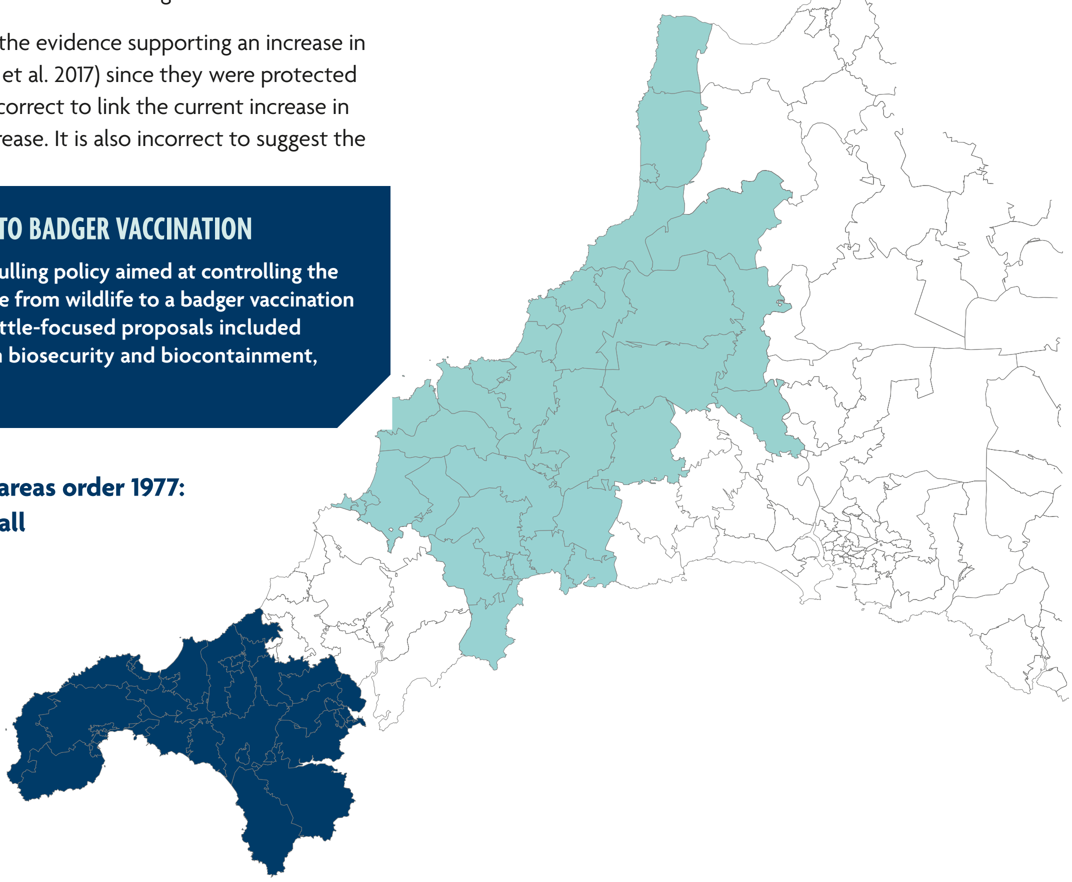
Furthermore, it must be remembered that, like cattle, only some of these infected badgers will actually be infectious. In one well-studied population of badgers, where infection was detected in around 3% of the population, bacilli were found to be excreted from the respiratory tract in only 1.5% of samples and in urine from only 0.5% of samples (Krebs 1997). The number of organisms shed from a badger is small compared to a shedding cow, approximately 400 shedding badgers would have to be eliminated to have the same environmental impact as one shedding cow.

The RSPCA acknowledges the evidence supporting an increase in badger populations (Judge et al. 2017) since they were protected in 1973, but believes it is incorrect to link the current increase in bTB to this population increase. It is also incorrect to suggest the protection of the badger has stopped badgers from being killed. The first Act in 1973 had provision for farmers to apply for licences and they were licensed to control badgers to prevent spread of bTB until 1975, when MAFF took on responsibility for doing so. In 1977, the Badger Control Order (BCO) identified parishes where actions were taken to remove badgers in bTB areas (e.g. see map 1). Between 1975 and December 1981, 185 operations (not including Thornbury) occurred in these parshes (e.g. see map 2, page 16, Dunnet et al 1986) – it is not known exactly how many badgers were killed, e.g. as many were gassed in setts, but it should be noted that incidence of bTB in cattle herds in the control areas fluctuated, but did not decline (MAFF 1983).

Approximately 11,000 badgers were also killed as part of the RBCT (Bourne 2007), many in similar areas to those in which badger culling operations had occurred previously (map 3, page 17). It is therefore reasonable to ask why, in places like Hartland, different badger removal operations over 30 years failed to eradicate bTB, especially if, as stated in some papers (Gallagher et al. 2007), some 80% of the badgers had been removed from that area. Some will undoubtedly argue this was because not enough badgers were killed but there were no limits placed on numbers, unlike the current policy. It could also be argued it was because the cull areas were not large enough (Bielby et al. 2014).

PROPOSAL 7: MOVING TO BADGER VACCINATION

To move from a badger culling policy aimed at controlling the possible spread of disease from wildlife to a badger vaccination policy, with the other cattle-focused proposals included (e.g. improved efforts on biosecurity and biocontainment, better testing, etc.).



Map 1: Badger control areas order 1977: Areas 1 and 2 in Cornwall

Area 1

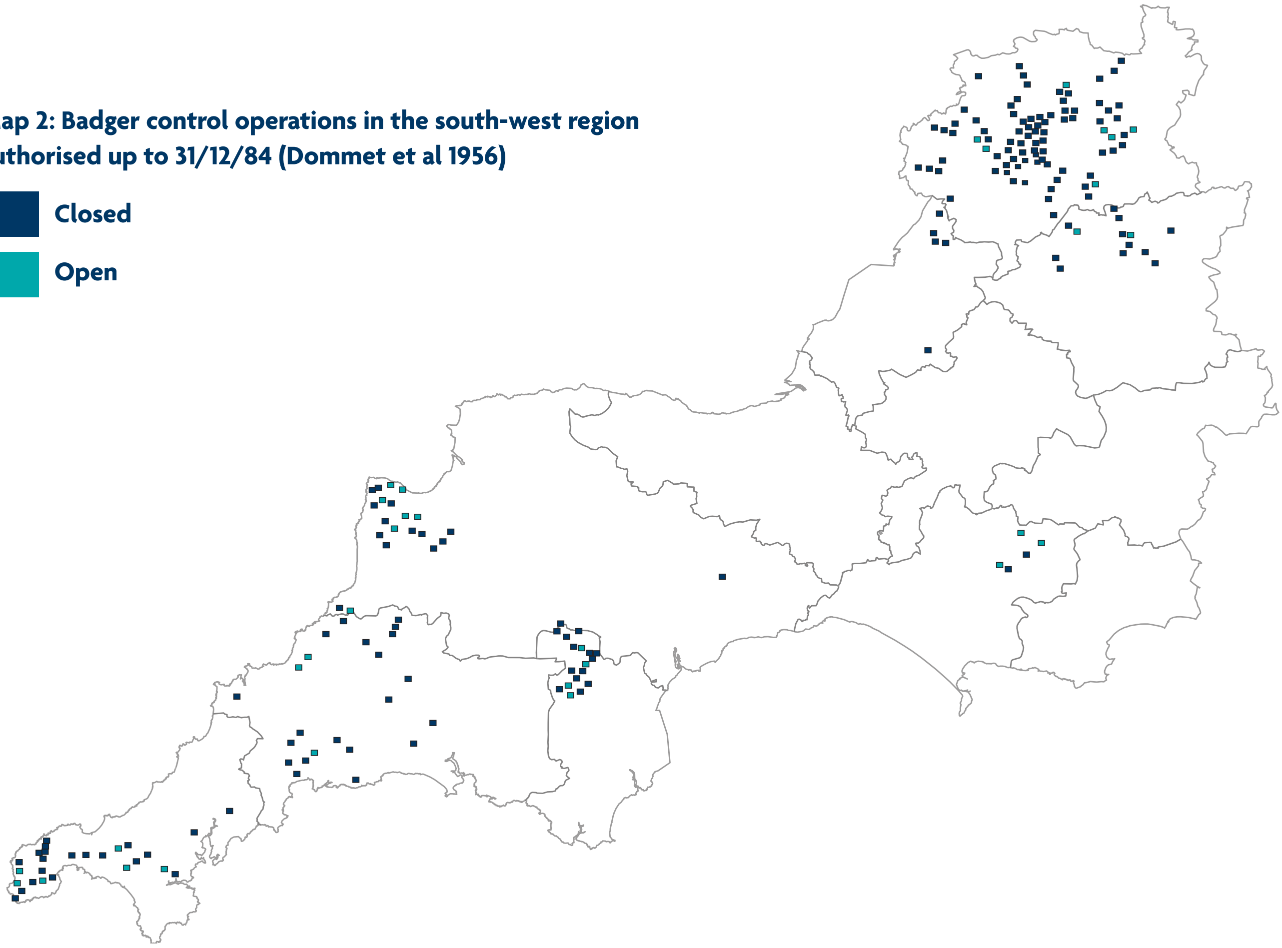
Area 2

19. https://gov.wales/sites/default/files/publications/2019-07/bovine-tb-badger-trapping-and-testing-on-chronic-tb-breakdown-farms-2018.pdf

Map 2: Badger control operations in the south-west region authorised up to 31/12/84 (Dommet et al 1956)

Closed

Open



Focusing on this link ignores the wealth of variables that may have contributed to the rise in bTB in cattle over the same period as discussed already, such as the changes in cattle breeds, the increased intensification of cattle farming and the increased movements of cattle, both locally as farms have become consolidated, and over the country as transport links have improved. Nevertheless, the RBCT did demonstrate that proactive badger culling can have an effect, albeit a small one, in reducing bTB in cattle (Donnelly et al. 2007) as well as showing that reactive culling, in the form practised by MAFF for a number of years, probably made matters worse, a view supported by subsequent analysis (Bielby et al. 2014).

The extent of the badger's role

Robust information on primary routes for infection of bTB in cattle is sparse, though most estimates clearly show that spread directly between cattle is the major source, with transmission directly from badgers accounting for only 5.7% (Donnelly and Nouvellet 2013).

The Independent Scientific Group (ISG) concluded, in their final report in 2007, that: *"Our results indicate that while badgers contribute significantly to the disease in cattle, cattle-to-cattle transmission is also very important in high incidence areas and is the main cause of disease spread to new areas"* (Bourne 2007).

Bourne, along with a number of other leading scientists in the field, also stated that badger culling could *"make no meaningful contribution to cattle TB control in Britain"*[19]. Recent comments from those directly involved in trying to control the disease have corroborated these sentiments, for example: *"Farmers will be going out tonight, shooting badgers, in the belief that it will solve the problem. It won't."*[20]

Badgers are largely being infected by cattle and any cattle infected by a badger spread this infection due to the poor management of the disease in cattle. If badgers were not being infected to such an extent by the cattle it is unlikely that any transmission would pass between the two.

Culling vs vaccination

There are risks associated with trying to control the disease by killing the wildlife reservoir. Evidence from the RBCT shows that badger culling seriously disrupts badger populations causing 'perturbation' in the remaining population, which increases the risk of disease spread (Donnelly et al. 2006), especially in areas next to the cull zones.

Maintaining the social stability of badger populations is therefore key to reducing the potential for them to spread infection. Vaccinating badgers against bTB allows action to be taken without disrupting the badgers' social structures.

Vaccination has been shown to reduce the severity and progression of bTB in badgers (Chambers et al. 2011) and, evidence from the Welsh Intensive Action Area (IAA) is that vaccinating badgers, rather than culling, along with stricter cattle control measures, has contributed to a 35% reduction in the incidence of bTB herd breakdowns in cattle (O'Conner 2017).

The consultation document on culling badgers in the Low Risk Area (Defra 2018) stated that an objective of the proposed cull was to reduce the potential for infectious contacts between badgers

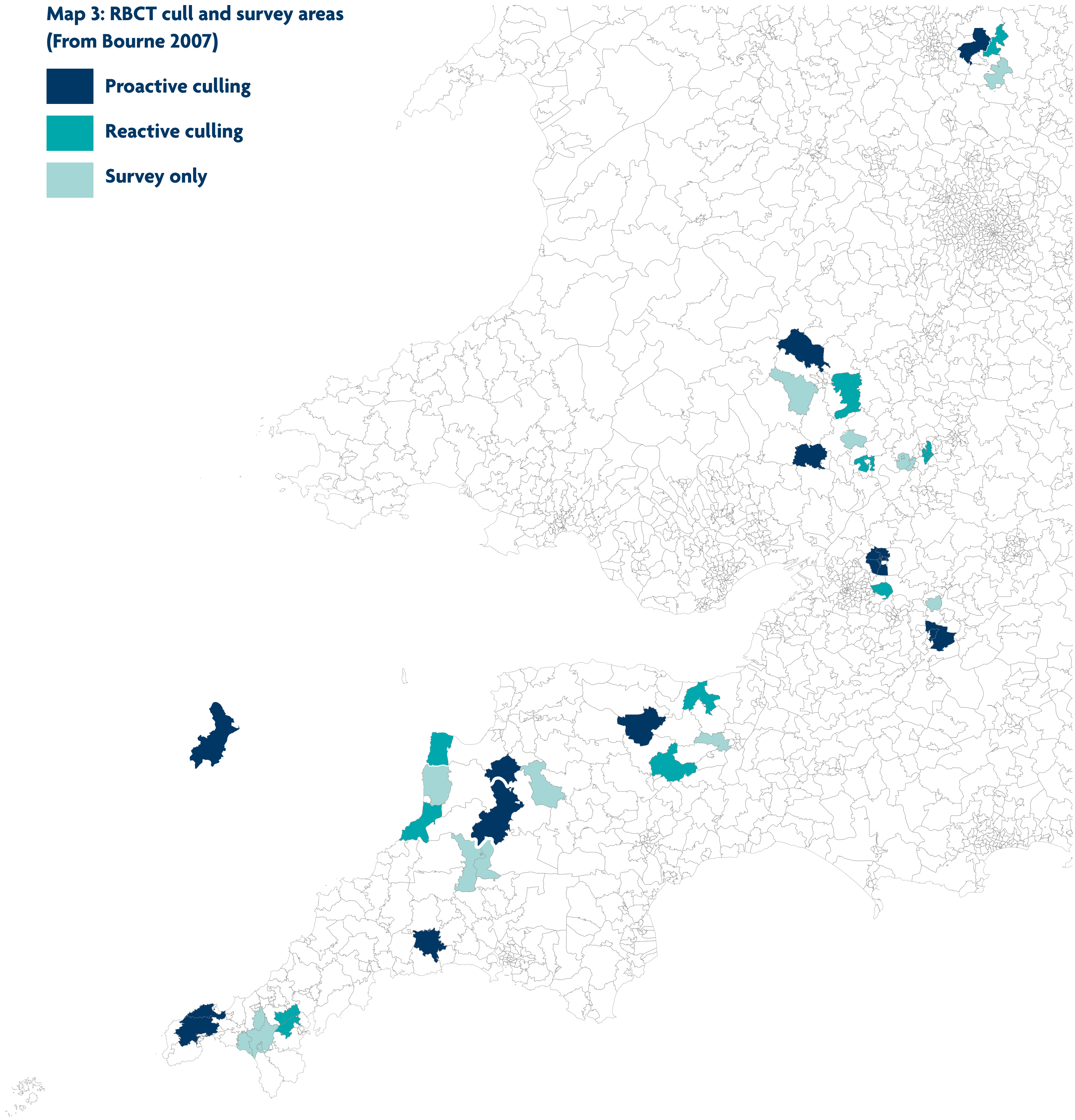
19. https://www.theguardian.com/uk-news/2015/sep/02/badger-cull-is-flawed-and-must-now-stop
20. https://www.thetimes.co.uk/article/tb-test-reveals-sick-cattle-lurking-in-herds-as-farmers-warned-badger-cull-not-a-cure-cq9rzqpqm

Map 3: RBCT cull and survey areas (From Bourne 2007)

Proactive culling

Reactive culling

Survey only



and cattle. This is despite the fact that, as yet, there is no evidence demonstrating how badgers transmit the disease to cattle. In fact, there is increasing evidence that it is unlikely to be through direct contact (Woodroffe et al. 2016).

The stated objectives of the cull are to contain and control the disease in cattle, but that this will be achieved by killing badgers. However, there is no indication as to how the respective effectiveness of the badger cull vs effectiveness of implementation of control measures in cattle will be assessed. Any programme of work to control the disease in cattle must focus on the cattle, especially in an area like Cumbria, where the evidence shows the disease was imported into the area through cattle (see paragraph 2.8, Defra 2018).

In our view, this demonstrates the failure of the current policy – badgers will be killed because current cattle measures failed to stop the importation/spread of this disease. Furthermore, this is the first time there has been a mention of eradicating the disease in wildlife as opposed to eradicating it in cattle. Eradication of the wildlife reservoir is completely pointless if the reservoir of disease in cattle persists and continues to infect more cattle and wildlife.

We also had concerns that the consultation on culling in the LRA (Defra 2018) stated that if effective and rapid intervention had been applied to the East Sussex hotspot the wildlife reservoir may not now be a problem. However, at least 174 badgers were removed between 1975 and 1996 (MAFF, 1997) from areas around cattle farms in East Sussex affected by bTB (Wilesmith et al. 1986), showing that intervention did occur but failed. Therefore, we would consider East Sussex to be an example that illustrates the proposed policy will not work.

Use of vaccination in wild animals can be effective in preventing the spread of disease long term. The best known example of the latter is rabies in Europe, where culling foxes over many years was ineffective in halting the spread of rabies but a programme of vaccination using oral baits has now effectively controlled and virtually eliminated rabies over large areas of the continent (Müller et al. 2015).

Badger vaccination is frequently cited as an alternative to culling. An injectable badger vaccine, Badger BCG, has been licensed for use in the United Kingdom since March 2010 and was introduced following 10 years and £11m of Defra-funded research and development. In 2012 more than 2,500 badgers were vaccinated using the injectable vaccine. Since then many more have been vaccinated in the Intensive Action Area in Wales (more than 5,000) (Welsh Government 2016) and the Badger Vaccine Deployment Project area in Gloucestershire (3,802 (Benton and Wilson 2015)) and as part of conservation organisations', such as the National Trust, the Wildlife Trusts, the RSPB and private individuals' vaccination programmes.

There is good evidence that an injectable bTB vaccine is both safe and provides at least partial protection in badgers, as it has been shown to reduce the severity and progression of bTB in infected badgers. Vaccinated badgers showed a reduction in lesions and bacterial count compared to non-vaccinated animals (Chambers et al. 2011) and further research has also shown that BCG vaccination in a wild population significantly reduces the risk of bTB infection in vaccinated badgers and unvaccinated cubs (Carter et al. 2012). The unvaccinated, susceptible cubs were indirectly protected from disease transmission through a 'herd immunity' effect[21].

The benefit of herd immunity is there is no need to vaccinate 100% of susceptible animals in a population to get a protective effect from vaccination, only enough animals to break the transmission cycle. A significant percentage of those wild badgers that receive an injectable vaccine are likely to become resistant to infection and/or disease and will play a reduced part in transferring the disease between badgers and cattle (Chambers et al. 2011). Therefore, repeated vaccination in an area is likely to reduce the level of bTB infection and disease in the local badger population and thus reduce the risk to local cattle from badger-to-cattle transmission.

One reason for not vaccinating is that culling removes the animal and so removes the problem. However, the social behaviour of badgers means culling may exacerbate the problem through perturbation and vaccination does not have this effect (Woodroffe et al. 2006). It must also be remembered that culling during the RBCT also increased the percentage of infected badgers in the remaining population, again increasing the risk to cattle (Jenkins et al. 2007).

Practicalities

It has been stated that vaccination is practically difficult[22] and expensive. One of the main reasons given for this is there is no way to deliver a vaccine to the badger without the badger being trapped and this would take time and staff to do[23].

However, given that roughly 40% of culled badgers killed so far in the cull have been trapped and shot, using traps paid for by the taxpayer, at least 40% of badgers culled could have been vaccinated. In three cull areas, over 60% of the badgers were trapped and shot in the first year of the cull, demonstrating that the need to trap does not, in fact, pose a credible barrier to the vaccination of badgers.

So a badger vaccination programme in targeted hot-spot areas can not only have an impact on the disease, but should also secure farmer support. This has happened after one project being run by the National Trust, which shows a big shift in the views of tenant farmers now trapping and vaccinating badgers has been shown to be practical[24].

A recent analysis comparing the costs of vaccination with those of culling indicates badger culling is both more expensive to government than was initially anticipated (by nearly £1,700 per km^2) and is five times more expensive to farmers taking part in the cull (£318km^2 compared with £61km^2 estimated by Defra) (Woodroffe 2018). The paper goes on to confirm that a large reduction in staff costs with vaccination has been demonstrated by the many vaccination projects that are currently underway and funded by Defra[25]. As scientists from the Food and Environment Research Agency (FERA) indicated while giving evidence to the Environment, Food and Rural Affairs (EFRA) select committee, volunteers might work in conjunction with professionals, which would reduce the costs of using the injectable vaccine to vaccinate badgers. As a result, the costs of volunteer vaccination are drastically cheaper, at £592 km^2 as opposed to £2,247 km^2, for industry-led culling. Furthermore, as badger vaccination is likely to be much more palatable to the general public, the costs of policing the bTB control zones will also decrease if culling was replaced with vaccination.

Vaccination modelling has shown that the differences between the outcomes of culling or vaccinating badgers are quite modest. Over a 300km^2 area, over a 10-year period, the difference between strategies appears to be less than one herd breakdown per year (Smith, McDonald, and Wilkinson 2012). This is further evidence to support the contention that vaccination can be as effective and practical as culling – and less controversial, less costly and more humane.

21. Herd immunity is a form of immunity that occurs when the vaccination of a significant portion of a population (or herd) provides a measure of protection for individuals who have not developed immunity.
22. Nigel Gibbens: We must work hard to make Britain TB free Western Daily Press 11/8/2014
23. https://www.nfuonline.com/tackling-tb-document--august-2013/ pg 11
24. Minutes of evidence. Northern Ireland Assembly Agriculture and Rural Development Committee: Bovine TB review - National Trust. 19th June 2012.
25. https://www.gov.uk/government/publications/badger-edge-vaccination-scheme-2-bevs-2/scheme-outline

The limits of culling: with Ireland as an example

It is interesting to note that recent advice to Defra, as proposed by the *Godfray Review*, is to consider vaccination as an exit strategy to culling, as the Irish Government is planning.

Extensive badger culling has taken place in Ireland over the past 25 years, and a reactive policy of badger culling in response to new incidents of bTB in cattle has been employed since 2004. A new cattle incident will trigger an intensive culling effort within a 2km radius of the affected farm, with the aim of reducing local badger density and then maintaining this low level (Byrne et al. 2013). It has been estimated that the national badger population in the Republic of Ireland has been reduced by some 60% since the mid-1990s as a result of this policy. (Byrne et al. 2013). In recent years, approximately 6,000 badgers have been killed annually resulting in a reduction in the prevalence of the disease in the badger population from 26% in 2007 to 11% in 2011 (Good and Duignan 2017), but not its eradication.

Between 2000 and 2010, the Irish cattle herd incidence fell from 8.2% to 4.7% (Duignan, Good, and More 2012) and this reduction in bTB cannot solely be a result of the badger culling policy (changes were made to the testing regime including increased use of IFN-γ). Herd incidence dropped to 4.18% in 2011 and 4.26% in 2012[26], implying the levels have plateaued despite ongoing removal of badgers over this time.

In a long-term study of the impact of badger removal in the Irish Midlands, 16 years of badger culling, and a substantial reduction of the badger population density, resulted in a decrease of some 22% in cattle herd bTB incidence, but ongoing culling continued to reveal infected badgers. If after such a long period of culling the wildlife reservoir continues to be infected it raises the question about when the end point of such policies would be.

The Republic of Ireland is now moving from a policy for badger culling to one of vaccination. Furthermore, it has introduced measures such as cost sharing, where farmers pay their vet to conduct one annual test of their herd (Good and Duignan 2017).

The recently published *Godfray Review* looking at the government's bTB eradication strategy stated that: "A very unfortunate consequence of the controversy around badger culling and the politicisation of the debate has been a deflection of focus from what can be done by the individual farmer and by the livestock industry to help control the disease."

The RSPCA agrees with this conclusion and would go further. It is our view that the focus on the need for badger control has led to the belief that badgers are the **primary cause** of bTB in cattle, whereas the primary source is likely to have always been an undetected reservoir of bTB in cattle. The *Godfray Review* offers support for this view, stating: "The lack of support for risk-based trading in the HRA also reflects a belief amongst many farmers that cattle movement is not a significant risk compared to infection from wildlife." (Godfray et al. 2018)

26. https://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/saveselections.asp

8. CONCLUSIONS

The RSPCA has been involved to some degree in the proposed strategies for bTB eradication for many years. We have, in the past, accepted the scientific consensus and accepted, but not supported, the culling of badgers. However, we feel the tide of evidence, collected during the RBCT and subsequently, shows the badger has been incorrectly identified by some as the main source for the transmission of bTB (e.g. Gallagher and Clifton-Hadley 2000) and the associated focus on this species has resulted in the current increase in the disease due to the lack of attention paid to what the evidence indicates is the primary source, notably cattle.

The RSPCA is concerned that possible causes identified in a report to MAFF in 1972 (Richards 1972) were ignored and the 'other' measures as defined by the ISG have not been implemented and/or are not being enforced effectively. As a result, bTB is still being transmitted from cattle to cattle and subsequently into the wild badger population, due to the failure to recognise that the disease has not yet been controlled in cattle. As was stated in the recent *Godfray Review*: "Today, bTB incidences in cattle, and possibly in badgers, are at best roughly stable. This cannot be allowed to continue".

The issuing of a licence for badger culling in Cumbria, in order to control an outbreak of bTB in cattle from a strain that has subsequently been found in badgers, highlights how far policy has deviated from the science due to the mindset that badgers are the primary cause. This strain of bTB was new to Britain, having been identified as a strain unique to Northern Ireland and imported to Cumbria through cattle movements before 2014[27]. According to this article, we have no way of knowing which bovine animal brought the disease over, or even if that animal is still alive. This is hugely significant. The culling of badgers was to reduce the risk of a wildlife reservoir becoming established, however, if the disease had not been introduced in the first place from the import of infected cattle, no wildlife would have been infected.

Outbreaks in Cumbria have been occurring sporadically since large numbers of cattle were brought into the county following the foot and mouth outbreak in 2001 (APHA 2017). The latest revelation that a new strain of the disease has been imported from Northern Ireland is another demonstration of consequences of the failure to have effective cattle controls in place to prevent these incidents from occurring. This was acknowledged in paragraph 2.8 of the consultation document on introducing badger culling into the Low Risk Area (Defra 2018). Now it seems likely badgers will have to pay the price, because they have been infected with this strain of the disease by cattle due to a failed policy based on an outdated testing regime and relaxed movement controls. This case study, in a nutshell, exemplifies the problem with the current bTB policy.

It is likely the hard work of farmers and others in reducing levels of bTB through strict cattle control measures put in place during the Area Eradication Scheme (AES) was wasted when MAFF policy switched from focusing on cattle to focusing on badger interventions, rather than considering alternatives, such as herd size, limitations of the test and the disposal of slurry. All three of these issues had already been identified as possible reasons for continued outbreaks in the West Penwith area of Cornwall (Richards 1972), and subsequent evidence has since demonstrated they may have a part to play yet still. As far as we are aware, they have never been fully explored, nor has it been properly impressed upon farmers the importance of these areas in controlling bTB in their herds.

We would, therefore, urge Defra to examine these areas of cattle husbandry. It seems entirely unacceptable that, after many years, we still do not know how the disease passes between cattle and badgers and vice-versa, if indeed the latter actually occurs. The RSPCA strongly advocates improvements in biosecurity measures in cattle, and the use of vaccination in badgers and (eventually) cattle as solutions to the problems associated with bTB infection. Cattle vaccination may be the final solution once the existing legal obstacles at an EU level have been overcome (and Brexit offers an opportunity to do this) after the recently developed 'DIVA' test has been validated by the World Organisation for Animal Health (OIE) and the relevant European laws are amended.

Finally, the RSPCA believes the biggest losers in the pursuit of this policy have been the farmers themselves. Having been told over many years the badger is the cause of the problem of bTB, they are now paying for a policy that is unlikely to provide them with the relief they so desperately need. Ironically, the creation of companies to manage the badger culls is an example of one way farmers could actually start to take control of this disease. These companies could be reformed to create bTB management groups to oversee bTB control in their area, encouraging the adoption of better herd management to eradicate bTB.

27. News and Star (2017) Don't kill badgers, farmers are warned http://www.newsandstar.co.uk/news/Dont-kill-badgers-farmers-are-warned-c97d4e17-defc-4365-a4fa-aa31981ff4ee-ds

9. RECOMMENDATIONS

In the light of all the evidence – scientific and practical – presented in this document, the RSPCA proposes the following recommendations to facilitate the eradication of bTB.

Cattle management

The RSPCA proposes each cattle herd should have a bespoke herd health and welfare plan and this should include management of bTB. Herds that are categorised as high risk, or suffer repeated breakdowns, or have had a long history of bTB problems, should be prioritised, but all farmers in the High Risk and Edge areas should have access to funding to help them develop these plans with their vets and if necessary, with input from other vets/ professionals with specific knowledge of the latest information on bTB risk reduction. These plans should include:

- Managing **biosecurity** effectively and robustly to prevent the disease entering a herd. This should include specific plans to prevent disease entering from:
  - Cattle, through:
    - purchasing and local movements
    - direct contacts
    - post-movement testing in the 'Edge Area'.
- Managing **biocontainment** and providing information around this topic. This can be done in a number of ways (Sibley 2018):
  - Quarantining high risk and infected animals
  - Managing colostrum
    - Pasteurising or dumping of colostrum from high risk cows
    - Managing slurry and potentially infected pasture
    - Establishing rest periods for pasture after infected/high risk animals have grazed
    - Drilling slurry and wastewater directly onto arable land
    - Granting producers money for investment into equipment such as injectors or thermophilic anaerobic digesters to 'treat' the slurry.
  - Managing feed and water troughs to prevent contamination
  - Improving **hygiene** in the cattle housing, for example through the use of well-managed automatic scrapers.
- Giving **tailored advice** to farmers with large herds of the risks involved including consideration of herd management systems tailored to each herd to reduce risks of infection, such as breaking up large herds into smaller groups, e.g having one herd of 300 separated into five smaller groups of 60. This would then contain the disease outbreaks.
- Allowing **farmers and vets more control** over decisions regarding bTB when a breakdown occurs in a herd, for example:
  - Facilitating the use of enhanced testing
  - Encouraging prompt culling of high risk cattle e.g. PPDbovine reactors.
- Introducing and validating **new cattle tests** for bTB, including PCR sampling of faeces and Actiphage
- Establishing **risk-based trading** and introducing measures to encourage uptake of the Cattle Health certification Standards
- Investigating the introduction of **vaccination of cattle** and the use of a DIVA test
- Giving **farmers the incentive to take ownership** of bTB control, such as by placing authority for issuing compensation payments to local farmers' cooperatives.

Wildlife

- Replacing badger culls with **badger vaccination** programmes.

Ideas for research

The RSPCA also proposes that more research needs to be done, particularly in areas relating to cattle husbandry, such as on the long term development of the disease in cattle and how this affects testing regimes.

PROPOSAL 8: SUGGESTIONS AND THE NEED FOR FURTHER TARGETED RESEARCH

That further research should be conducted to investigate and review:

- **Survival of bTB in the environment grazed by cows, especially under cow pats (earthworms (Barbier et al. 2016))**
- **Progress of the disease through a cattle herd**
- **Analysis of cattle movements and the relationship with bTB in Britain (for example a repeat of the work done by Gilbert et al. 2005), along with new badger survey data**
- **Risk factors at individual farm level – why do some farms never get TB despite being in HRA hot-spot areas?**
- **The role of endemic disease and how that has evolved.**

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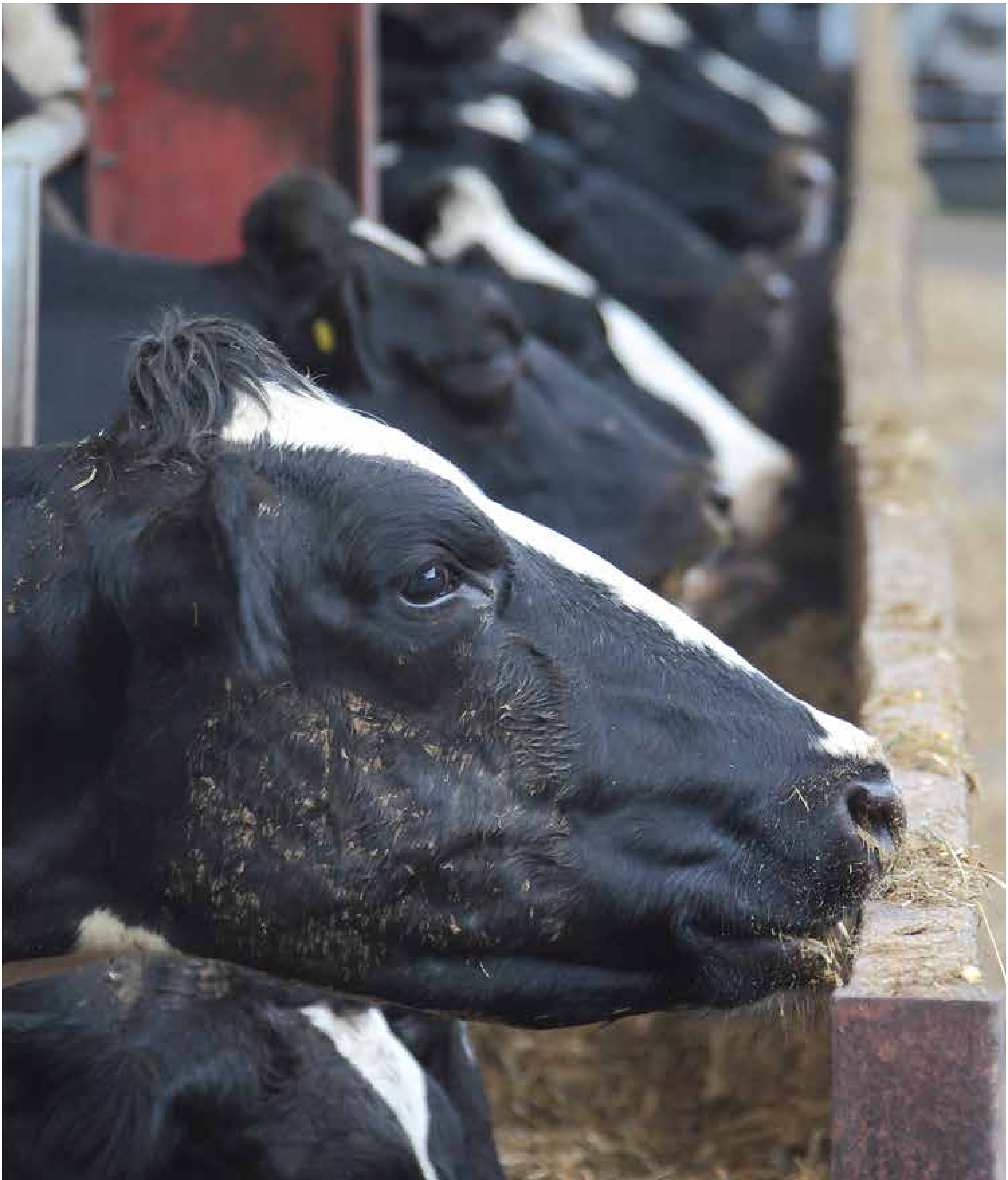

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