



September 2019

Dear Consultee

RSPCA consultation on proposals for management measures for eradicating bovine TB in England and Wales.

We are writing to invite views on a fresh set of proposals for management measures that the RSPCA would like to see implemented to halt the spread of, and ultimately eradicate, bovine TB in cattle in England and Wales.

Bovine Tuberculosis (bTB) and 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 to huge numbers of cattle and badgers. Recent and more historical data indicate that current approaches are failing to bring this devastating and widespread disease under control, let alone eradicate it. A more humane, evidence-based and sustainable solution is urgently needed.

The RSPCA does not support the current badger culling policy, which is being expanded year on year with no evidence of its effect on bTB. Historically, the organisation has been supportive of scientific investigations and trials on the association between badgers and bTB infections, but we - along with many international experts - believe the current culling programme has no scientific basis. These arguments are detailed in the accompanying document *It's not all black and white – Managing bTB: an evidence-based approach*, which sets out a more in-depth reasoning behind our proposals, along with references to the relevant literature to support our arguments.

Responses

This consultation seeks views from farmers, vets, industry advisors and any other interested parties or individuals who have a view on the future management of bTB. The consultation is being held on this [website](#) and will open on 17th September 2019 and will close after six weeks on 1st November 2019. These responses will help develop our own approach to drive positive and decisive action.

Confidentiality and data protection

The consultation will be anonymous. The RSPCA is using SurveyMonkey™ to collect these consultation responses. SurveyMonkey's™ privacy notice can be found [here](#). By completing this survey you are agreeing that we can use this data to complete our consultation. If you should have any questions, please feel free to contact us at: bovinetbteam@rspca.org.uk

A report summarising the results of this consultation will be published by us in due course.

It is our belief that everyone wants the same outcome – successful management, and ultimately, eradication of bTB in both farmed and wild animals. The RSPCA hopes to join with other industry bodies to align messaging and provide support in the many areas in which we are unified on this matter. The RSPCA is committed to helping farmers in managing and eradicating bTB. If you would be interested in taking advantage of this please email: bovinetbteam@rspca.org.uk and we will contact you in due course.

Introductory questions

1. Please let us know about your profession (tick all that apply):

Farmer (owner), farmer (tenant) land agent, farm advisor, farm manager, veterinary surgeon, scientist/academic/researcher, NGO employee (animal charity, nature conservation charity etc)

Interested member of public; other?

2. How long have you been in this profession?

0 – 5; 5 – 10; 10 – 20; 20 – 30; More than 30 years; N/A

3. Please tell us which area you are in as defined by bTB strategy in

- England: High risk area (HRA), Low risk area (LRA), Edge area
- Wales: High TB Area; Low TB Area; Intermediate area
- Scotland

(circle as applicable)

4. For England, please tell us if you live in a badger cull area

- Yes
- No
- Don't know/not sure

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.

Studies done with farming communities in areas with relatively high incidences of bTB have shown the disease has a huge impact on farming communities, leaving many feeling helpless and resigned.

The badger cull in England, when introduced in 2013, was the first opportunity farming communities had to come together and proactively address the disease as a local community. The year-on-year increase in cull licences applied for and granted shows how much the farming community has pulled together to address the disease in the only, and most obvious, way they have been allowed and sometimes encouraged to do. Each licence requires:

- landowners to sign up to their land being accessible for culling to take place on it
- significant financial investment from those setting up the company, and
- coordination: to apply for the licence, ensure the requirements of the licence are met and the personnel to carry out the culls is equipped and trained.

This needs an underlying dedication and cooperation. We believe this to be a demonstration of the desire and commitment of local farming groups to effectively control bTB, and an opportunity to expand the role of these structured groups.

We propose these community groups, currently focussing on badger culling, should be restructured to manage all aspects of bTB control at a local level – from biosecurity implementation to enhanced testing uptake so 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.

There has been poor uptake of biosecurity and TB management advice currently offered free or heavily subsidised by such schemes as the TB Advisory Service ([TBAS](#)) and Cymorth Wales. It is acknowledged this poor uptake may be due, at least in part, to a lack of awareness, but it is necessary that farmers engage with these initiatives since badger culling alongside the current testing regime will not achieve the bTB control required for the Officially TB Free (OTF) status the government and industry are seeking.

- 5. Do you agree with our proposal that the cull companies should be restructured into bTB control cooperatives with the ability to offer grants or other schemes?**
- 6. How can those agencies currently offering grants or free schemes improve farmer engagement and uptake?**
- 7. What do you think the current schemes have done/failed to do to achieve better uptake?**

Proposal 2: Strengthening biosecurity, biocontainment and cow resilience

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

Cattle management

We believe it is important farmers take more ownership of the management of the disease. As a first step, this could be through developing robust bTB management plans with their own private vet, who has undergone additional specific training.

We believe the bTB Farm Management Plan should include all aspects of preventing and controlling bTB and be specific to the farm, taking into account size, husbandry systems and resources.

The plan should consider:

- Biosecurity – the risks of disease entering the herd, and how these risks can be effectively managed to predict and prevent a herd becoming infected with bTB
- Biocontainment – the risks of disease spreading within the herd if it already exists, and how these risks can be managed in the case of an outbreak
- Resilience – the risk of individual susceptible animals to succumb to the disease and how this can be managed, through husbandry, nutrition and genetics
- Surveillance – the best use of the tests available, including statutory and non-statutory tests, to detect disease and identify infected and infectious animals.

Biosecurity requirements

Currently, members of badger culling companies have to have biosecurity measures in place: *“Reasonable biosecurity measures are ... implemented by participating farmers on their land to provide a strong protection against the spread of infection. For this purpose ‘reasonable measures’ means measures that in the particular circumstances are practicable, proportionate and appropriate, having regard to the bTB Biosecurity Five-Point Plan¹.”* These are reviewed by Natural England (NE) though spot-checks were only conducted on 5% of farms involved in the culling. However, these measures are not comprehensively detailed. For Approved Finishing Units (AFUs) there are terms and conditions which must be met, and the most recent proposal for Approved Finishing Units: Extended (AFUEs), had the most comprehensive set of biosecurity measures within the terms and conditions of any to date. The relevant measures should be extended to all cattle producers at high risk of a bTB breakdown, especially those partaking in a badger cull.

¹ Defra (2018) Guidance to Natural England: Licences to kill or take badgers for the purpose of preventing the spread of bovine TB under Section 10(2)(a) of the Protection of Badgers Act 1992 pg 5

Biocontainment requirements

Biocontainment (the steps taken to reduce the risk of a disease spreading through a herd) is rarely addressed as a topic in itself in the context of bTB management.

Like many aspects of controlling this disease, biocontainment measures are likely to require financial input and management changes. They will, however, also likely result in improvements in other aspects of cattle farming and welfare. Measures such as good colostrum management, improved buildings, and steps to reduce the stress of the animals, e.g. through improving comfort, reducing social mixing during the production cycle, etc. could all be considered according to the individual farm's situation.

- 8. Do you agree with our proposal that each and every cattle farm should have a farm-specific TB Management plan?**
- 9. If you currently have a Herd Health Plan, does it include measures to prevent or reduce the risk of infection by bTB:**
 - Within the herd or between herds?
 - Between cattle and wildlife?
- 10. If not, is this something you would discuss with your vet when next reviewing your herd health plan?**

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.

Government currently spends over £100m per year on the control and eradication of bTB. Each new breakdown in the high risk area is estimated to cost £19,032 (2018 prices) with government costs amounting to £8,929 and farmer costs of £10,103. However, there is no significant funding directed at those farms that do not have a breakdown but are at risk through poor biosecurity. There is an opportunity to direct funding at prevention rather than control.

We believe that alongside free advice services, such as the TBAS, and/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. We are convinced that, although this has significant financial implications in the short term, in the longer term the removal of the animals will have a real effect in reducing bTB in the cattle population and will have a smaller net cost along with the many benefits from achieving true OTF status. In the Welsh bTB eradication programme, the targeted chronic farms receive financial advice as part of the package, as it is acknowledged that TB 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 and 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.

11. Do you agree with the proposal to review funding mechanisms for controlling and eradicating bTB, so that farmers are incentivised to prevent bTB entering their herds, rather than compensated for having it?

12. Do you think any of the following could be used to create better funding to prevent and control bTB (5 strongly agree – 1 strongly disagree):

- Capital grants to improve handling facilities and allow more thorough skin testing
- Capital grants to help implement biosecurity and biocontainment measures
- Graduated compensation payments dependent on compliance with biosecurity and biocontainment standards i.e. 'earned recognition'
- Premiums for products (meat and milk) from TB Free herds
- Financial support for specialist veterinary advice for prevention and control of bTB in the form of a farm-specific TB Management plan.

Proposal 4: Strengthening and supporting the role of vets

- a) 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.
- b) Government to facilitate applications by private vets to carry out further testing (i.e. using other tests alongside the single intradermal comparative cervical test (SICCT) through developing clear guidelines published on the [TB hub](#) after reviewing and simplifying the process with input from private vets.

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 TB testing on their clients' farms, but proactive planning and discussion about how to tackle bTB on-farm has rarely been carried out.

Whilst initiatives such as the TB Advisory Service and various industry conferences are welcome, relatively few farmers and vets engage in such events or services. There is a potential for a network of specifically trained vets to become TB advisors akin to the Accredited Johnes Veterinary Advisors who make up part of the successful National Action Johnes strategy.

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 (see Proposal 5 and the accompanying document *It's not all black and white* for details of the potential benefits of using these). It is vital the government facilitates the private vet's access to these tests. We propose a thorough review, undertaken with practising private vets, to simplify the process where possible and culminating in clear guidelines about the availability and use of novel tests as part of a TB management plan on the TB hub. This should give private vets confidence they can complete the process in line with the law and quickly so it is easily manageable.

13. Do you think a network of specifically trained Accredited TB Advisors should be facilitated to provide specific advice on bTB prevention and control through private veterinary practice, working in partnership with APHA?
14. Do you have any other suggestions as to how the veterinary profession can become more involved in contributing to the management of bTB on individual farms and across industry as a whole?

Proposal 5: Improving the approach to and accuracy of testing

- a) **Government to address the factors that affect the sensitivity of the SICCT while it continues to be the main test used for identifying infected animals.**
- b) **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 persistently and recurrently infected herds.**

The UK currently uses the SICCT to screen herds for bTB infection. 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.

Different tests have different abilities to detect the organism. The SICCT has a high specificity but a low sensitivity (i.e. if the test is negative, there is a high chance the animal is actually infected and the test has ‘missed’ the presence of the organism – this could be as many as 50 infected animals testing negative out of every 100 infected animals tested). No test is perfect and some with lower specificity will cause healthy animals to be slaughtered, but will have a higher sensitivity so are less likely to leave infected animals in the herd.

The sensitivity of the routine SICCT to detect infected animals can vary markedly with such external factors such as the tester, physiological status of the animal, season, and concurrent disease. Some diseases currently endemic in the UK cattle herd are known to interfere with the SICCT, for example Bovine Viral Diarrhoea (BVD) (de la Rua-Domenech et al. 2006). In some cases of endemic disease the effect on the SICCT is well established, however, for other diseases the research is lacking or, although it may make sense logically e.g. due to the disease’s effects on the immune system, a connection with bTB is not clearly established.

However, there are other tests available. These include tests that can detect bTB organism in the faeces (which would suggest an animal is shedding) and a test that can detect organisms in the blood (the ‘Actiphage’ test, which is currently unvalidated). Tests for the presence of antibodies against the bTB organism in cattle body fluids e.g. blood, saliva, etc. – such as Idexx, Elisa and Enferplex – are also available to complement the SICCT. Although none of these tests give a perfect answer we believe ‘parallel testing’ (where several tests are used on one animal/in one herd) should have a much greater role.

15. **Do you think the current testing regime, using a combination of different interpretations of the SICCT and gamma interferon, is adequate for eliminating bTB?**
16. **Do you agree with our proposal that government should continue to further investigate the efficacy of the SICCT, including the variability in sensitivity, and consider enhanced testing systems, particularly in persistent and recurrently infected herds?**
17. **Do you think novel tests, which may not currently be validated or recognised by the authorities, should be made readily available for use alongside in parallel with the statutory testing programme (i.e. parallel testing)?**

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.

Biosecurity advice is available for farmers through the TB hub and the TB Advisory Service, which aim to support their efforts to prevent bTB breakdowns. The advice is predominantly aimed at preventing badgers and cattle mixing and is based on research conducted between 2005 and 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).

It is unfortunate that official advice on prevention of bTB appears to focus on badger controls, rather than the issues of biosecurity and biocontainment involving cattle to cattle transmission and environmental contamination from cattle shedding large numbers of bTB bacteria.

Announcements stating the two pilot badger culls in Somerset and Gloucestershire have succeeded in reducing bTB in cattle are open to challenge². The evidence (APHA 2018) indicates incidences in bTB have declined dramatically, but the starting point used for measuring this decline was three years prior to the culls starting, indicating bTB was already declining before culling began. The conclusion of the report also clearly states “*these data alone cannot demonstrate whether the badger control policy is effective in reducing bTB 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*”.

We are also concerned with regards how the conclusions of the Godfray report have been reported. The Godfray Review, in our view, weighed up the pros and cons of both culling and alternatives, stating: “*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*”.

Official guidance and advice for farmers and vets involved in the prevention and control of bTB should be based on fact and best practice. Effective controls should be prioritised and practical ways of implementing advice should be offered.

18. Please indicate your view on priorities for prevention and control advice by putting the following strategic advice in priority order, from 1 to 12, with 1 being highest priority:

- Purchasing policy for incoming cattle
- Environmental contamination from cattle
- Slurry management
- Direct cattle-to-cattle contacts over fences

² <https://www.gov.uk/government/news/new-data-shows-drop-in-bovine-tb-as-further-measures-to-fight-disease-unveiled>

- Environmental contamination from wildlife
- Direct wildlife-to-cattle and cattle-to-wildlife contacts
- Shared equipment that may be contaminated
- People who have direct contact with animals (e.g. vets, technicians) moving from farm to farm
- Local movements of cattle between farm premises
- Retention of infectious animals that are not correctly identified by the official testing programme
- Badger culling
- Badger exclusion.

19. Please indicate who you think is best qualified to provide prevention and control advice to farmers, in order of effectiveness from 1 to 6, with 1 being the most effective:

- Local private vets
- APHA Staff
- TB Advisory Service
- Specifically trained vet network (akin to the BCVA Accredited Johnes Advisors)
- NFU advisors
- Farm assurance schemes

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, along with the other cattle-focused proposals included (e.g. improved efforts on biosecurity and biocontainment, better testing etc.)

Historically, the debate raged over the role of badgers in the spread and maintenance of bTB, despite several reports, much research and well over 20,000 badgers killed between 1975 and 1997. In 1997, it was proposed a trial be conducted to try and answer this question once and for all (Krebs 1997). The Randomised Badger Culling Trial (RBCT) was the largest trial of its kind ever attempted with nearly 11,000 badgers killed. The RSPCA did not oppose the trial as it recognised more evidence was needed. The result was it did show that proactive badger culling does have a *small* effect in reducing new incidents of bTB in cattle by about 16%, showing badgers are implicated, but the conclusion of the authors of the final report was “*badger culling can make no meaningful contribution to cattle TB control in Britain*” (Bourne 2007). This is corroborated by a paper suggesting while 38% of cases of cattle bTB could be attributed to badgers in the areas studied, only 5.6% of cases were due to direct transmission, and the rest were due to onward cattle-cattle transmission (Donnelly and Nouvellet 2013).

It was therefore disappointing and perplexing that the Government announced in 2012 that farmers would be licensed to cull badgers. So far nearly 67,000 badgers have been culled, and while recent announcements appear to support the idea the cull is working, even the authors of the report on which these announcements were based stated “*these data alone cannot demonstrate whether the badger control policy is effective in reducing bovine TB in cattle*” (APHA 2018). As outlined in Proposal 6 above, such discrepancy between the conclusions of advisory reports and associated public announcements from others can result in misperceptions and confusion and highlights the vital importance of such announcements being evidence-based and holistic.

Badger vaccination is considered to be a viable alternative to culling by many, with many advantages such as cost, and the avoidance of perturbation, which has the potential to make the disease situation worse in areas of culling (Jenkins et al. 2007).

Vaccination programmes, unlike culling, enable badger social groupings to remain relatively stable (Donnelly et al. 2007) (Woodroffe et al. 2006). Although it does not fully protect animals from getting the disease it does reduce the chances of them becoming infected and reduces excretion of the bacilli if they are. Cubs can also be conferred immunity.

The cost of vaccination is frequently raised as a barrier to its use. However, a report by the Zoological Society of London shows volunteer led vaccination would be cheaper to implement per km² per year than the current cull policy (Woodroffe 2018) (£592 for vaccination as opposed to £2,247). One of the contributors to the cost is the need to trap animals, but the data from the culls shows some cull zones are killing more badgers by trapping/shooting rather than free shooting, implying that trapping is not proving to be an obstacle to some of the cull companies. Currently there are several funding schemes for vaccinating badgers, for example the Government BEVS scheme, and also schemes led by charities such as county wildlife trusts.

- 20. Do you think vaccination should be considered as a viable alternative to culling?**
- 21. Do you think it would be acceptable and practical to offer badger vaccination within the current cull zones for those farmers who don't wish to cull, but want to engage in bTB control?**
- 22. If so, do you think there should be more support for farmers to work together to implement large scale vaccination programmes?**

Proposal 8: Suggestions and the need for further targeted research

We propose further research should be conducted to investigate and review:

- Survival of bTB in the environment grazed by cows, especially under cow pads (earthworms – (Barbier et al. 2016)
- Progress of the disease through a cattle herd
- 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 the 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.

There are many questions remaining about bTB, especially since much of the scientific research since the 1970s (when it was first found in badgers) has focused on the badger's role in the disease. Although we think more research would be useful in understanding the disease and improving the methods used to control it, we also believe we know enough now to take the revised approaches outlined in this document and with the current situation there is not time to go through the necessary processes for more research. We also believe the majority of funds should be going into disease control while the incidence and prevalence of bTB in cattle are not in decline.

23. Do you agree with the suggested research topics we have listed above or do you have other suggestions for future research to help manage bTB?

Conclusion

The RSPCA believes badger culling will not have the hoped for effect on bTB control in cattle. We would like to see the policy instead be re-focused on improved bTB control in cattle and control in wildlife via vaccination. We are convinced by the available evidence that there is a large, undetected reservoir of bTB in the cattle population, which the SICCT is not robust enough to detect. We also acknowledge that, as in Wales, greater control of the disease in cattle may cause a short term effect of increasing numbers of cattle culled, and that farmers will need the necessary financial advice and support to continue a viable business during this time. The effects of any increased culling could be aided by more robust management and husbandry to speed the control and eradication of the disease. Ultimately though, the increase in numbers of cattle killed will, in the long run, mean fewer cattle become infected and are culled as the benefits of becoming truly OTF become apparent.

We believe there is scope already to improve the biosecurity and biocontainment measures being taken by cattle producers and these need implementing as a matter of urgency through tailored bTB Management plans for each farm, drawn up by the farmer in collaboration with either the farm vet, and/or by specially trained advisors. We also believe farmers should be effectively and appropriately incentivised to prevent and control bTB in their cattle.

We would like to work with producers and industry bodies in those areas in which we can be aligned to present a united front to the government in order to ensure effective changes are made so we start to see a true and sustained decline in bTB incidence. We acknowledge that for any new industry-led initiative to work, it has to have the support of the farmers who will ultimately implement it, and so we hope you will be willing to engage with us, beyond this consultation.

We thank you for the time you have taken to fill out this consultation. If you would like to find out more about the RSPCA's policy on bTB or would like to be involved in any further work we do in this area please email: bovinetbteam@rspca.org.uk

References

APHA. 2018. "Bovine TB in Cattle: Badger Control Areas Monitoring Report – For the Period 2013 – 2017." APHA.

Barbier, Elodie, Benoit Chantemesse, Murielle Rochelet, Léon Fayolle, Loïc Bollache, Maria Laura Boschiroli, and Alain Hartmann. 2016. "Rapid Dissemination of Mycobacterium Bovis from Cattle Dung to Soil by the Earthworm Lumbricus Terrestris." *Veterinary Microbiology* 186 (April): 1–7.

Bourne, F. J. 2007. "Bovine TB: The Scientific Evidence. A Science Base for a Sustainable Policy to Control TB in Cattle. An Epidemiological Investigation into Bovine Tuberculosis. Final Report of the Independent Scientific Group on Cattle TB. Presented to the Secretary of State for Environment, Food and Rural Affairs, The Rt Hon David Milliband MP, June 2007." DEFRA.

Brunton, Lucy A., Christl A. Donnelly, Heather O'Connor, Alison Prosser, Stuart Ashfield, Adam Ashton, Paul Upton, et al. 2017. "Assessing the Effects of the First 2 Years of Industry-Led Badger Culling in England on the Incidence of Bovine Tuberculosis in Cattle in 2013–2015." *Ecology and Evolution*. <https://doi.org/10.1002/ece3.3254>.

Donnelly, C. A., G. Wei, W. T. Johnston, D. R. Cox, R. Woodroffe, F. J. Bourne, C. L. Cheeseman, et al. 2007. "Impacts of Widespread Badger Culling on Cattle Tuberculosis: Concluding Analyses from a Large-Scale Field Trial." *International Journal of Infectious Diseases: IJID: Official Publication of the International Society for Infectious Diseases* 11 (4): 300–308.

Donnelly, Christl A., and Pierre Nouvellet. 2013. "The Contribution of Badgers to Confirmed Tuberculosis in Cattle in High-Incidence Areas in England." *PLoS Currents* 5 (October). <https://doi.org/10.1371/currents.outbreaks.097a904d3f3619db2fe78d24bc776098>.

Gilbert, M., A. Mitchell, D. Bourn, J. Mawdsley, R. Clifton-Hadley, and W. Wint. 2005. "Cattle Movements and Bovine Tuberculosis in Great Britain." *Nature* 435: 491–432.

Jenkins, H. E., R. Woodroffe, C. A. Donnelly, D. R. Cox, W. T. Johnston, F. J. Bourne, C. L. Cheeseman, et al. 2007. "Effects of Culling on Spatial Associations of Mycobacterium Bovis Infections in Badgers and Cattle." *The Journal of Applied Ecology* 44: 897–908.

Judge, Johanna, Robbie A. McDonald, Neil Walker, and Richard J. Delahay. 2011. "Effectiveness of Biosecurity Measures in Preventing Badger Visits to Farm Buildings." *PloS One* 6 (12): e28941.

Krebs, J. R. 1997. "Bovine Tuberculosis in Cattle and Badgers: Report to The Rt Hon Dr Jack Cunningham MP." PB 3423. London, UK: MAFF.

Rua-Domenech, R. de la, A. T. Goodchild, H. M. Vordermeier, R. G. Hewinson, K. H. Christiansen, and R. S. Clifton-Hadley. 2006. "Ante Mortem Diagnosis of Tuberculosis in Cattle: A Review of the Tuberculin Tests, γ -Interferon Assay and Other Ancillary Diagnostic Techniques." *Research in Veterinary Science* 81 (2): 190–210.

Woodroffe, R. 2018. "Eradicating TB from Cattle and Badgers – a Review of Evidence." https://www.zsl.org/sites/default/files/media/2018-09/ZSL_Eradicating_TB_Report_final_24Sep18.pdf.

Woodroffe, R., C. A. Donnelly, D. R. Cox, F. J. Bourne, C. L. Cheeseman, J. Delayay, G. Gettinby, J. P. McInerney, and W. I. Morrison. 2006. "Effects of Culling on Badger Meles Meles Spatial Organization: Implications for the Control of Bovine Tuberculosis." *The Journal of Applied Ecology* 43: 1–10.