

Bovine Tuberculosis Related Husbandry / Biosecurity Research

Background information

1 Introduction

The Husbandry Group began its work on the development of the husbandry advice for bovine tuberculosis (bTB) in July 2006. The first stage was a comprehensive review of current research and other evidence. A list of the measures from existing advice and research, including The Philips Report: *TB and Cattle Husbandry, Report of the Independent Husbandry Panel* (May 2000) and the recent Central Science Laboratory (CSL) research on badger visits to farmyards (SE3029), was compiled. The Husbandry Group then worked to identify which of the evidence based measures farmers could have some assurance worked, were practical and gave some value for any investment required. Every farm is different and a pragmatic approach is needed for many measures related to minimising bTB risks. The Group emphasised that a farm specific Herd Health Plan developed between the farmer and their vet is essential for improving and maintaining the health status of a herd. The veterinary surgeon is able to contribute a combined knowledge of animal health and management issues specific to the farm.

The advice on husbandry measures was informed by the whole of the TB research programme; however, a relatively small amount of research has been conducted on husbandry measures. Information from the many existing biosecurity leaflets were also presented to the Group for the consideration.

2 Advice produced

The TB Husbandry Group produced advisory leaflets (published in February and May 2007). These are not a complete list of all advice available, but instead focus on what the Husbandry Group consider to be the priorities to communicate to farmers (based on evidence and what is considered practical). The leaflets cover how to reduce the chance of disease transmission from badgers to cattle, and from cattle to cattle.

The TB Husbandry Group also has a page on the Defra website where advice is available. This advice is reviewed and revised based on new and emerging research, as well as any feedback received.

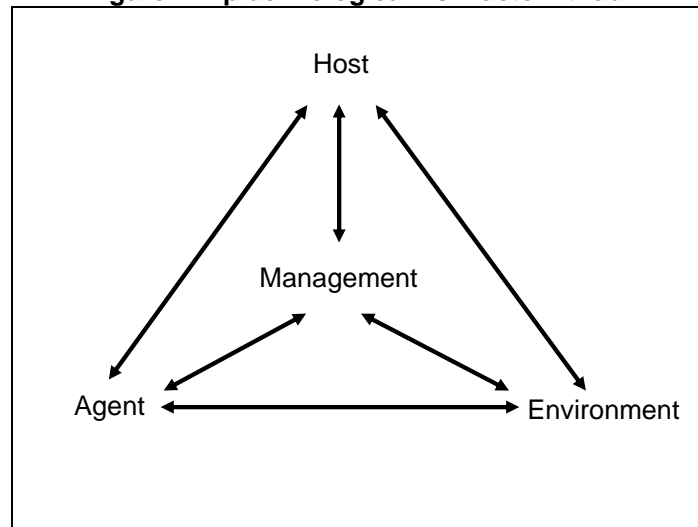
The headline of highest priority is for farmers **to securely store their feed. This is not only to reduce the risk of contamination of feed troughs or stored feed by badgers (as well as other wildlife), but also to reduce the chance of badger visits to cattle yards and sheds where nose-to-nose contact could result.** The video footage of badgers and other wildlife in farm buildings from CSL's initial study on badger visits to farmyards (SE3029) emphasised this as activity not dependent on the health status of the badger, although it has also been shown that badgers in the late stages of TB show aberrant, behaviour including an increased occupation of farm buildings. The footage showed badgers visiting farm buildings and 'relaxing' in feed stores on a regular basis. The BCVA has put this on their website at: <http://www3.enabledsites.co.uk/bcva/default.asp?sectionID=-1&pageID=243333>.

3 Biosecurity and Disease Risk

The relative importance of each route of transmission of bTB is not fully understood, therefore, when considering biosecurity issues in general, it is important **to visualise the risk factors and pathways for disease transmission**. The risk factors can be classified as:

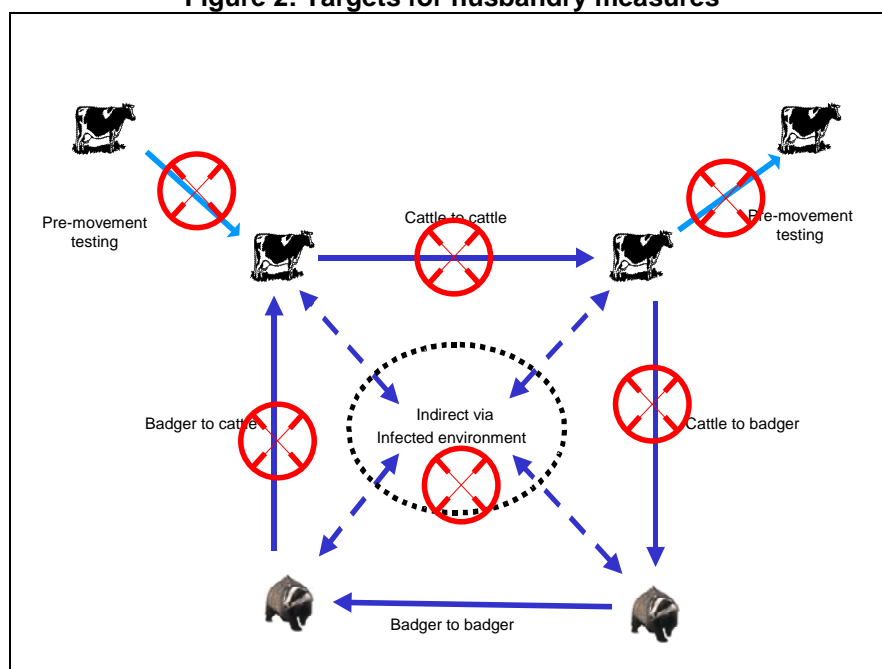
1. Agent (*Mycobacterium bovis*) related risk factors e.g. ability to survive in the environment.
2. Environmental risk factors e.g. season.
3. Host (cattle and badgers) e.g. behaviour, immune response, pathology.
4. Management e.g. husbandry.

Figure 1: Epidemiological risk factor "triad"



The routes for transmission of *M. bovis* infection are shown in figure 2. The only route of infection that is not amenable to intervention by husbandry measures is transmission from badger to badger. Effective interventions for some of the other transmission pathways, e.g. badger to cattle contact at pasture, are possible but may not be easy to achieve.

Figure 2: Targets for husbandry measures



4 Current knowledge gaps identified by Bovine TB Husbandry Group

The Husbandry Group suggested that with regard to bTB, the following were the main knowledge gaps that limit effective biosecurity / husbandry interventions:

1. Badgers

- a. An understanding of what proportion of badgers visiting feed stores / farm buildings are infected with bTB.
- b. An understanding of the actual mechanism of transmission of infection.

2. Biosecurity

- a. The effect that biosecurity measures may have on the bTB incidence in neighbouring cattle herds and badger social groups.
- b. The effectiveness of badger deterrents such as yard dogs, water jets and pigs.

3. Management/ environment

- a. Slurry and manure, and their ability to act as reservoirs of infection, which could then be transmitted to cattle i.e. the survival of *M. bovis* and (a) whether slurry or manure ever achieves the correct aerosol particle size to cause respiratory infection, which is the primary site of the disease; and (b) the risk associated with spreading muck on a field then immediately grazing it
- b. Types of cattle feeder and modifications to existing equipment (this is covered by current CSL research).
- c. Survival of *M. bovis* in silage has been reported in research in 2002 by the Veterinary Laboratories Agency (VLA), but it should be considered whether further research was useful.
- d. Research on badger latrines, e.g. the effects of management interventions such as weed killing, and whether this encourages badgers to move the latrine elsewhere
- e. The effect of cleaning out water and feed troughs.

4. The *M. bovis* agent

- a. The ability of the *M. bovis* organism to survive in the environment.
- b. The ability of *M. bovis* surviving in the environment to infect wildlife and cattle.

5. Other hosts

- a. The prevalence of *M. bovis* in deer (this is covered by current research due to report in early 2008 and SE 3010).

Following extensive discussion by the Group, it was agreed that much of the research that was practically possible had been, or was being, carried out (see below). Knowledge gaps still exist, particularly for example the relative importance of routes of transmission, and these are discussed below.

5 Research that the Husbandry Group agrees has been carried out

The Group agreed that many aspects of required husbandry research in relation to badger-cattle contact had been carried out under the CSL husbandry project SE 3029 (see link at section 10), and is being addressed further in the follow-on project SE 3119. An epidemiological investigation of risk factors associated with TB breakdowns has been carried out in the Independent Scientific Group on Cattle TB's (ISG) studies TB 99 and CCS 2005.

6 Research that is needed and is in progress

The Group agreed that the following needs are covered by research that is currently in progress:

1. **The prevalence of *M. bovis* in wild deer** is being further investigated in two prevalence surveys being carried out in the south-west of England and the Cotswolds. Results are expected to be available by January 2008.
2. **Developments in practical adaptations of farm buildings and equipment** such as feeders etc. in order to make them less accessible by badgers and the costs of doing this are being addressed in the CSL study SE3119. This new project aims to identify and measure the benefits and costs associated with two broad husbandry practices by manipulating them on a series of farms within a factorial experiment. The benefits derived from each measure, both in isolation and in combination with others, will be assessed as the ability to reduce the frequency of badger visits to farmyard resources and quantify the effect this has on the risk of badger-cattle interactions (both direct and indirect) as a result of farmyard modifications. This project is due to finish in mid 2010.
3. **Cost-benefit of husbandry interventions** is included in SE3119 which involves an investment appraisal to identify and estimate the costs of each husbandry practice. The results are due in 2010.

7 Information gaps that Husbandry Group agreed it is not possible to fill at present

The Husbandry Group agreed that it was not possible to determine important information for several important factors relating to *M. bovis* and preventative measures:

1. **The relative contribution of the various routes of transmission (figure 2).** This had been investigated by research carried out in the past, which even under controlled laboratory conditions, had been unable to provide the important information required. It is known that cattle-to-cattle transmission is important, and that badgers, and probably to a lesser extent deer, play a role. However, the relative contribution of the different routes of infection, are likely to differ widely under different farm conditions.
2. **An indication of what proportion of badgers that visit cattle feed stores are infected with *M. bovis*.** i.e. how many sick or infected badgers preferentially seek out feed stores due to the easy availability of food.
3. **Further research on the ability of *M. bovis* in the environment to infect wildlife and cattle.** Experience has shown this to be a particularly difficult aspect to study; however, whilst there is some ongoing research related to this, it cannot cover all the variation that would be encountered in the field, and is likely to only be able to address a narrow range of conditions.

4. **The effect that biosecurity measures have on bTB incidence on neighbouring farms by altering the behaviour of local badger social groups.** The size of the study (in excess of 900 farms) required to demonstrate an effect with sufficient statistical rigour makes such a study impractical.

8 The Husbandry Group's suggested list of future research requirements

From the knowledge gaps, the Group highlighted the following future research requirements as important:

1. **Research on badger latrines and any management interventions** e.g. the effects of managing badger latrines and whether this encourages badgers to locate latrines elsewhere.
2. **M. bovis in the environment**, development of techniques for (i) determining the presence and abundance of *M. bovis* in the environment, (ii) the viability of the organism and (iii) its ability to infect both wildlife (badgers, deer) and cattle. Some work has been done on aspects of this; however, it is a particularly difficult area of work as the survival of *M. bovis* in the environment varies widely under different conditions
3. **Survival of M. bovis in silage.** This has been covered in a pilot research project carried out by the Veterinary Laboratories Agency (VLA) in 2002, but it should be considered whether further research was useful.
4. **Further research on slurry and manure management**, and the potential for survival and spread of *M. bovis* in slurry and manure. In particular, the risk associated with grazing fields recently spread with slurry and manure and the associated risk to wildlife.
5. **The effectiveness of badger deterrents**, such as yard dogs, electric fencing, and pigs.

9 Why certain aspects of intervention measures are missing from the advisory leaflets

Some obvious areas are missing from the advisory leaflets because either (1) there was no evidence there would be a significant impact; (2) the information needed was not available since research has not yet been carried out; (3) it is acknowledged that it is not possible to obtain robust answers due to practical constraints; or (4) based on current evidence there were few or no practical measures that could be suggested. Examples are below:

1. **No evidence that actions would be of significant impact, e.g**
 - a. **the growing of maize and production, storage and use of maize silage.**
There is anecdotal evidence that badgers are attracted to maize and maize silage and in areas where maize is grown it often forms a major part of their diet, but there is no hard evidence to suggest that reducing the amount of maize / changing from maize to grass silage can reduce bTB.
 - b. **The spreading of slurry on grazed land.**
A Veterinary Risk Assessment has been carried out into the potential dangers of spreading slurry on grazed land, and concluded that:
Slurry has the potential to spread bovine TB via two routes: ingestion (via the pharynx and gut) and respiratory (via the lungs); however, in order to do this, the slurry must first contain viable *M. bovis* organisms in sufficient quantity. This is

highly unlikely under the conditions existing in the UK as a result of current cattle controls.

For slurry to be a source of infection for bovine tuberculosis a number of important events must take place in sequence: At least one bovine in the herd must be (1) infected AND (2) infectious AND (3) shedding bacteria in faeces or urine.

The infected slurry must contain (4) an infectious dose of (5) viable *M. bovis* AND these must (6) come into effective contact with at least one (7) susceptible animal via the respiratory system or the gut.

In order to do this, it must (8) survive storage and the (9) environment, either on or in the ground, or in the air as an aerosol, for long enough to contact a susceptible animal.

Within the recipient animal, the organism must (10) reach a suitable site AND (11) survive to replicate.

In parallel with the above there is an important dilution effect of air, uninfected soil and uninfected slurry that greatly reduces the likelihood of infection. It is also important to note that the oral dose required for infection swallowed via the gut is considerably greater than that required for infection inhaled via the respiratory system.

Given the difficulty in determining the role of slurry in disease spread, advice on this was not included in the leaflets because it was not certain that it could be expected to have any effect.

2. The information needed was not available since research has not yet been carried out, e.g.

a. management of latrines:

Latrines would have to be actively managed after fencing them off, otherwise the lack of grazing would ensure a lush growth of grass which could make the likelihood of indirect contact greater by attracting the attention of cattle to the area. Other effects of managing / interfering with latrines were also a concern: both excessive grass growth or treatment with herbicide may discourage use of the latrine and result in badgers moving latrines to other sites. The effect of management on badger behaviour was identified as an area that required further research, as was information on cost-effective types of fencing that are easy to install and maintain.

3. It is not practically possible to isolate the direct impact of one measure, e.g.

a. effect on TB herd incidence.

It is only possible to see an impact of the cumulative effect of measures as a whole.

4. Based on current evidence, there are few or no practical and evidence-based measures that could be suggested, e.g.

a. disease risk at pasture from badger urine on grass.

10 Other sources of information:

1. BCVA

<http://www.bcva.org.uk/default.asp?sectionID=166639>

2. Defra

http://www.defra.gov.uk/wildlife-countryside/vertebrates/reports/TAN_22.pdf

3. TB and cattle husbandry – The Philip’s Report “The role of cattle husbandry in the development of a sustainable policy to control *M. bovis* infection in cattle”

The objective of this report, published in 2000, was to conduct a fast-track review of scientific evidence on the effects of cattle husbandry on bTB and to suggest means of limiting the disease by improved animal husbandry.

<http://www.defra.gov.uk/animalh/tb/publications/hpanel.pdf>

4. SE 3029 CSL Husbandry Research Report, October 2006

An investigation of potential badger / cattle interactions including the extent of badger visitations to farm buildings and food stores, and how cattle husbandry methods may limit these.

http://www2.defra.gov.uk/research/project_data/More.asp?I=SE3029&M=CFO&V=CSL

5. Research on silage – Defra research project SE3022, April 2002

The link for the final report is found at:

http://www2.defra.gov.uk/research/project_data/More.asp?I=SE3022&M=KWS&V=SE3022&SUBMIT1=Search&SCOPE=0

6. Defra funded bovine TB research projects

N.B. these cover all research areas and are not limited to husbandry projects.

<http://www.defra.gov.uk/animalh/tb/research/projects.htm>

7. Main Defra TB information page (including information on pre-movement testing, gamma interferon and the single intradermal comparative cervical tuberculin (SICCT) test)

<http://www.defra.gov.uk/animalh/tb/index.htm>

8. Qualitative Veterinary Assessment of the risk of transmission of bovine tuberculosis through the disposal on farm land of cattle slurry and manure from TB breakdown herds

<http://www.defra.gov.uk/animalh/tb/pdf/tbdoc0108.pdf>

9. Independent Scientific Group on Cattle TB chapter 6- Analysis of farm level risk factors (chapter 6)

http://www.defra.gov.uk/animalh/tb/isg/pdf/final_report.pdf

10. Farm Health Planning

BCVA: <http://www.bcva.org.uk/default.asp?sectionID=166639>

Defra Farm Health Planning: <http://www.defra.gov.uk/animalh/ahws/fhp/index.htm>