Northern Ireland Assembly

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Briefing Paper

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Mark Allen

The link between Bovine TB and Badgers – an overview of key research and policy milestones from the Krebs Review/Report to the Environment, Food and Rural Affairs Committee Inquiry.

1 Background and context

Bovine Tuberculosis, which is caused by the *Mycobacterium bovis (M bovis)* affects the health and welfare of cattle, lowers productivity and fertility and consequently impacts on herd keepers' profitability.

As things currently stand, within the UK, only Scotland has achieved officially Bovine TB free status (herd incidence of less than 0.20%) and recent data would suggest that Bovine TB incidence in England, Wales and Northern Ireland has actually increased,

rather than decreased (see table 1). Ireland has also yet to reach the standard for Official Bovine TB status but has reduced the disease incidence.

Country	Herd incidence % in 2010	Latest annual herd incidence %
England	8.72%[1]	10.73% (situation on 2/11/11)[2]
Ireland	4.65% (31/12/2010)[3]	4.18% (31/12/2011)[4]
Scotland	Officially Bovine TB free since 2009 (herd incidence rate of 0.18% in 2010[5])	Officially Bovine TB free since 2009 (herd incidence rate of 1.52% in 2011[6])
Wales	6.57%[7]	6.47%(1Jan to 31st Aug 2011) [8]
Northern Ireland	**5.12%**	**6.01%[9] (31/12/11)**

Table 1: Bovine TB Herd Incidence statistics - UK and Ireland

It is within this context that the role of the wild badger population in the potential spread and control of Bovine TB continues to attract much attention and controversy. What is an established fact is that the wild badger population is a reservoir for TB but what is less clear is how the interaction between cattle and badgers contributes to the incidence of the disease in both species of animal.

This briefing paper provides an overview of the main efforts carried out under the instigation of successive UK governments to both better understand the relationship between TB incidence in cattle and badgers as well as associated work that has been taken to control and eradicate the disease. Figure 1 sets these interventions within a timeline ranging from 1996 to 2008.

It should however be stressed that the majority of this work is focussed on GB and more particularly England and Wales, given Scotland's officially Bovine TB free status which has resulted in little if any work focussed on the research relating to badgers and the transmission of bovine TB[10].

[1] Defra do not provide Bovine TB herd incidence statistics and this figure is derived from Detailed TB statistics 1Jan to 31 Dec 2010 by taking the number of Total New TB incidents as a proportion of the Total number of herd tests conducted. One of the problems with this form of incidence calculation, is that it doesn't take into account risk based testing. Herds in higher risk areas are tested on an annual basis, whereas herds in lower risk areas are tested every second, third or fourth year. The problem with this from the incidence point of view, is that as you change the testing policy, you influence the incidence rate. Detailed TB Statistics, GB by region, 1 Jan to 31 Dec 2010, Defra

[2] 2011 Provisional annual projections for England – extrapolated from data from the first six months of the year ,UK (GB) Bovine TB Eradication Plan 2012, Defra, 14th September 2011.

[3] Bovine TB statistics, Department of Agriculture, Fisheries and Food, DAFF website, 19th September 2011

[4] Bovine TB statistics, Department of Agriculture, Fisheries and Food, DAFF website, 5th March 2011

[5] Derived from Defra data Detailed TB Statistics, GB by region, 1 Jan to 31 Dec 2010, Defra

[6] Derived from Defra data - Detailed TB statistics, GB by region, 1st January to 31st August 2011, Defra

[7] Derived from Defra data Detailed TB Statistics, GB by region, 1 Jan to 31 Dec 2010, Defra. The Welsh figures may well be lower than the English figures as a result of The Welsh Government currently having an annual testing policy for all herds, including the lower risk herds in the north of Wales, which will partially explain why the incidence rate in Wales is lower than in England – in effect the impact of high risk areas is diluted by the tests from low risk areas.

[8] Derived from Defra data - Detailed TB statistics, GB by region, 1st January to 31st August 2011, Defra

[9] Bovine TB statistics - Cumulative herd incidence in year (%), December 2011, DARD

[10] Scottish Parliament Question S3W-23642: Liam McArthur, Orkney, Scottish Liberal Democrats, Date Lodged: 07/05/2009 and answer from Richard Lochhead (21/05/2009):

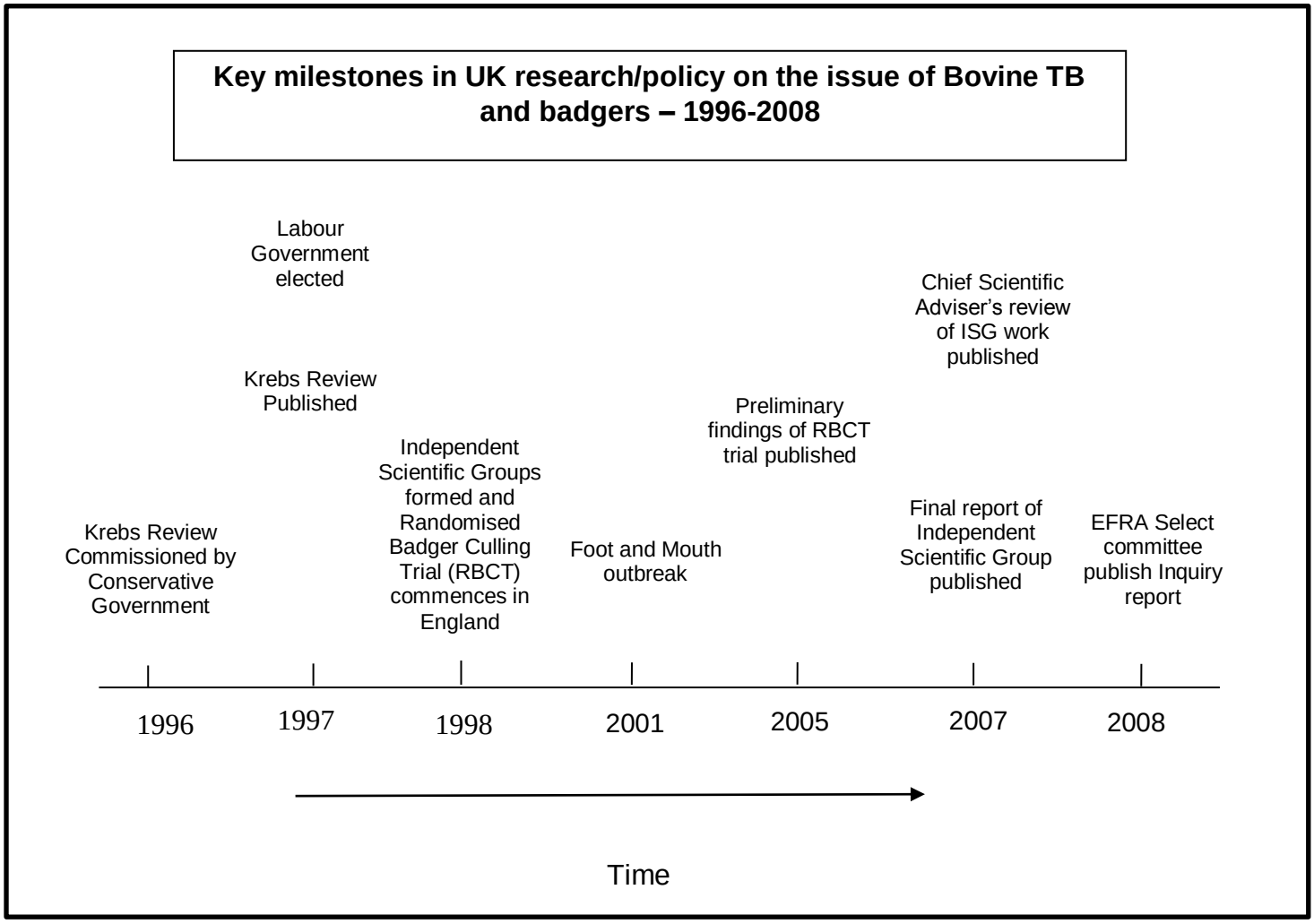

Figure 1: Key milestones in UK research/policy on the issue of Bovine TB and badgers – 1996-2008

2 The Krebs Review/Report

The work that led to the publication of the so called Krebs Review/Report was instigated by the then Conservative Government in 1996 with the actual terms of reference given to Professor Krebs and the Independent Scientific Review Group being as follows:

'To review the incidence of tuberculosis in cattle and badgers and assess the scientific evidence for links between them; to take account of EU policies on reducing and eliminating the incidence of tuberculosis in cattle; to take account of any risk to the human population; and accordingly to review, in light of the scientific evidence, present Government policy on badgers and tuberculosis and to make recommendations'.

In seeking to meet these terms of reference, Professor John Krebs and the other members of the Independent Scientific Review Group considered a range of existing scientific evidence from different sources.

Focussing on the specific issue of the evidence for a link between TB in cattle and badgers the Krebs review gathered and considered scientific evidence under particular themes as set out in the finalised Krebs Review/Report which was published in 1997[11].

2.1 Krebs Review/Report Conclusions

On the basis of the available scientific data the Krebs Review/Report made conclusions that included:

Theme	Conclusions
Background	• **Bovine TB is not a uniquely British problem and as such it is important to learn from experience in other countries;** • **Bovine TB has severe economic implications for affected farms** • **The money spent on Bovine TB research is small given the economic cost of the disease and the uncertainties surrounding many key issues;** • **The relatively small amount of research currently contracted out does not reflect that best use is being made of available expertise;** • **Badgers are not an endangered species and the badger protection legislation confers on badgers a degree of protection which is beyond that necessary to preserve their current distribution.**
Evidence for the transmission of *M bovis* from badgers to cattle	• **Several wildlife species are infected with *M bovis*** with notable examples being moles, foxes, mink, rats, wild deer (red, roe fallow and sika) and ferrets. This work also established that **prevalence was higher in badgers when compared to these other sample species**, **although it was recognised that the sample suffered from unquantifiable biases;** • **Available evidence also suggested that only animals that actively shed bacteria are infectious**. On this basis evidence established that **bacteria shedding lesions associated with *M bovis* were only to be found in ferrets, deer and badgers**; • There is **strong circumstantial evidence to suggest that badgers represent a significant source of *M bovis* in cattle**; • The **causal link between *M bovis* infection in badgers and cattle herd infections has not been proven due to the lack of controlled, randomised experiments carried out to date, and the fact that sampling for isolates is too infrequent and does not cover other wildlife species**;
TB in badgers	• **Badger density appears to have increased in parts of Britain** over the last 10 years (1987-1987); • **Badger removal operations are not a threat to overall badger numbers with badgers killed on the roads exceeding the number removed** • **Transmission of *M bovis* from badgers to cattle would be most likely to occur when infected badgers deposit sputum, urine, faeces or pus containing bacteria into the environment which they share with cattle**; • **TB infection can be highly localised within infected badger**

[11] Krebs J Professor, Independent Scientific Review Group, Bovine Tuberculosis in Cattle and Badgers, 1997

Theme	Conclusions
	populations and transmission seems to occur more frequently within, rather than between social groups; • **Badgers prefer to forage on short grass pasture, where cattle are also less likely to avoid grass contaminated by badger urine and faeces**
Spatial and temporal trends in *M bovis* infection in cattle and badgers	• **A survey of road traffic accident badgers offers the best available source of information in the underlying prevalence of TB in badgers**; • **Monitoring *M bovis* strains over time in cattle, badgers and other wildlife should, in principle provide conclusive evidence on whether and to what extent badger to cattle transmission takes place**; • **The present MAFF protocol for attribution of the cause of herd breakdowns is not sufficiently vigorous**.
Control Strategies	• There is **some evidence to suggest that the gassing and clean ring strategies were more effective than the interim strategy in reducing the prevalence of TB in badgers** and hence also, theoretically reducing the risk of herd breakdowns; • **TB prevalence in MAFF taken badgers culled as part of removal operations has been high, and higher than road traffic accident badgers tested over the same period;** • **Fertility control is likely to be less effective than culling as a strategy to reduce TB in badger populations** and hence any transmission to cattle; • **Quantitative data in recolonisation time is scant**; • **Trapping may not always be the most efficient method of removal of badgers** – the efficacy, cost and welfare implications of alternative methods, including stop-snaring should be further considered • **If badgers are the cause of a substantial number of breakdowns, husbandry could make an important contribution to tackling the problem.**
TB diagnosis and vaccines	• Development of a **cattle vaccine currently appears more viable than a badger vaccine, but is premised on the fact that any cattle vaccination programme would require a diagnostic test capable of differentiating between infected, including cattle infected following vaccination, and vaccinated animals**; • **Small scale badger removals may not substantially reduce contact between cattle and infected badgers because partial removal of social groups causes disruptions in territorial and dispersal behaviour and this may actually increase the risk of transmission to cattle**;

Table 2 : Key Krebs Review/Report conclusions

2.2 Krebs Review/Report Recommendations

Drawing on their findings the Krebs team also made recommendations that included:

Theme	Recommendations
The link with badgers and other wildlife	• The **attribution of the cause of cattle herd breakdowns should be made more transparent and all breakdowns should be classified according to the presence of absence of badgers in the area**. Information on whether or not infection has been detected (including the severity of any infection) in any badgers present should also be recorded where this information is available; • The **risk to cattle from wildlife, other than badgers, should be assessed in areas of high herd breakdown risk taking account of the key factors of prevalence of the disease, severity of the disease and its effect on infectivity, abundance of the species and the extent of contact with cattle including the movement range of the wildlife**;
Field studies of badgers	Future **research on badgers should include** 3 priorities: (i) extensive surveys that will contribute to **analyses of how variation between local areas in the risk of herd breakdown is connected with badger presence or absence and variations in the prevalence and severity of the disease in badgers**; (ii) using **molecular epidemiology to understand more about the badger to cattle transmission dynamics within intensively studied areas**; (iii) **estimation of recolonisation times** at sites subject to the proactive and reactive culling strategies;
Epidemiology of the disease in badgers and in cattle	• A **limited reintroduction of the road traffic accident survey targeting within areas with high or increasing herd breakdown rates and nearby areas with low breakdown rates**. Data gathered in this way on the prevalence and severity of the disease will allow a more rigorous analysis of the link between herd breakdowns and the prevalence of TB in badgers over time and space; • An **analysis should be carried out to determine the correlates of local variation in risk.** Relevant data will include presence/absence of badgers, prevalence and severity of TB in badgers, husbandry, climate and landscape variables;
Molecular typing of the infective agent	• **Extending the use of molecular fingerprinting tools to analyse the spatial and temporal dynamics of the disease in badgers and other wildlife as well as cattle**. This should be a carefully designed, intensive study over restricted areas. The optimal procedure would involve a combination of two or more methods of molecular typing;
Modelling	• The **use of mathematical modelling should be extended due to its value in better understanding the epidemiology and control of *M bovis* in badgers**
Badger management and control strategies	• The **development of a randomised block experiment of three strategies: a reactive culling strategy; a proactive culling strategy and a no culling strategy that should be initiated by**

Theme	Recommendations
	Spring 1998 and which should have the ownership and participation of farmers at an operational level; • **Further research should be done on recolonisation times in areas subject to reactive and proactive culling strategies**; • **No badger culling should be carried out outside the proposed experimental hot spot areas;** • An **independent Expert Group including statisticians and mathematical epidemiologists should be established to oversee the detailed experimental design**, including the final determination of the areas to be included in the experiment; • The **possibility of testing various proactive husbandry strategies should be explored with the farming industry to determine how effective these might be in reducing risk**;
Diagnostic tests	• Work on the **development of improved TB tests for badgers should be pursued in the context of the vaccination programme**, but this should have a lower priority than development of the vaccine related diagnostic test for cattle; •
Vaccines	• The **best prospect for control of TB in the British Cattle herd is to develop a cattle vaccine and this should be a high priority** whilst acknowledging that this a long term policy and success cannot be guaranteed; • **Vaccine development work should be co-ordinated with comparable programmes for human TB** and that MAFF should give further consideration to how this might most effectively be achieved; • **Progress on the development of a cattle TB vaccine should be formally reviewed after 5 years**; • As **use of a TB cattle vaccine is prohibited by current EU legislation due to the fact that it would compromise the tuberculin skin test. In this context the development of a specific diagnostic test that can detect and differentiate between infected animals, including those that have become infected even after vaccination, vaccinated animals and this should be developed alongside work on a vaccine**; • The **option of a badger vaccine, using information gained in cattle work, should be retained as a fall back option if the cattle vaccine requirements cannot be met**;
Biological control	• Further consideration should be given to **developing techniques for reducing TB infection in badgers through biological control, for example using bacteriophages (virus that infects and destroys bacteria) to destroy M bovis in the environment;**
Data availability	• Should be a **clear commitment by government to ensure that TB data is made readily available to researchers at the earliest opportunity**;

Theme	Recommendations
Research	• MAFF should **ensure in future that research is commissioned from those with the best expertise from throughout the UK research community and MAFF should also look at partnerships with industry, universities and other funding agencies to develop a more co-ordinated approach;** • **Government should review the amount spent on research in absolute terms and consider whether the allocation of resources between research and control costs is correct and the extent to which it would be reasonable for the main beneficiaries (farmers) to contribute to the control costs from which they benefit directly**.

Table 3: Key Krebs Review/Report recommendations

3 The UK Randomised Badger Culling Trial (RBCT)

3.1 Background and methodology

The Randomised Badger Culling Trial (RBCT) , also commonly referred to as the Krebs Trial, was instigated to determine the impacts of different types of badger culling on the incidence of Bovine TB within the UK, but all of the trial areas where located within England.

The motivation for the RBCT can be found within the recommendations of the previously discussed Krebs Review/Report. The specific recommendation that led to this course of action called for *'…a randomised block experiment of three strategies: a reactive culling strategy, a proactive culling strategy and a no culling strategy*[12]*.'*

In making this recommendation the Krebs Review/Report team were seeking to meet the need to establish whether badger culling could be effective in the control of Bovine TB.

In light of this and other recommendations, in 1998 the Labour Government also decided to establish an Independent Scientific Group (ISG) on Cattle TB. The ISG designed and oversaw the implementation of the RBCT but also undertook a range of other work, which is often overlooked, dealing with issues such as Bovine TB diagnosis, pathogenesis (manner of development of a disease) and the control of TB in cattle and badgers.

On the specifics of the RBCT, the ISG decided to conduct the cull within 30 high risk areas for cattle TB within England. Each of the 30 pilot areas measured approximately 100km², and these 30 areas were grouped into 10 sets of 3, each called a triplet which were further divided as follows (see figure 2 also):

- 1 area was subjected to approximately annual culling across all accessible land (proactive culling);

[12] Krebs J Professor, Independent Scientific Review Group, Bovine Tuberculosis in Cattle and Badgers, 1997, page 128.

- 1 area exercised a local cull of badgers on or near where recent outbreaks of TB had occurred in cattle (reactive culling); and
- 1 area received no culling (survey only) and effectively acted as a control against which comparison could be made.

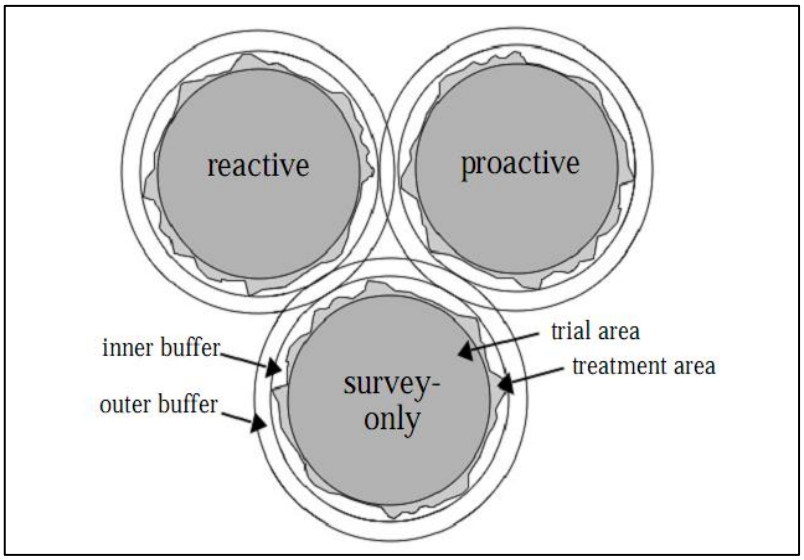

Figure 2: Schematic representation of trial areas in a triplet[13]

The distribution of the 30 areas in which work was undertaken is set out in figure 2 below which also groups these areas into their 10 constituent triplets (A-J) as well as indicating whether the area was subject to a proactive, reactive or no cull.

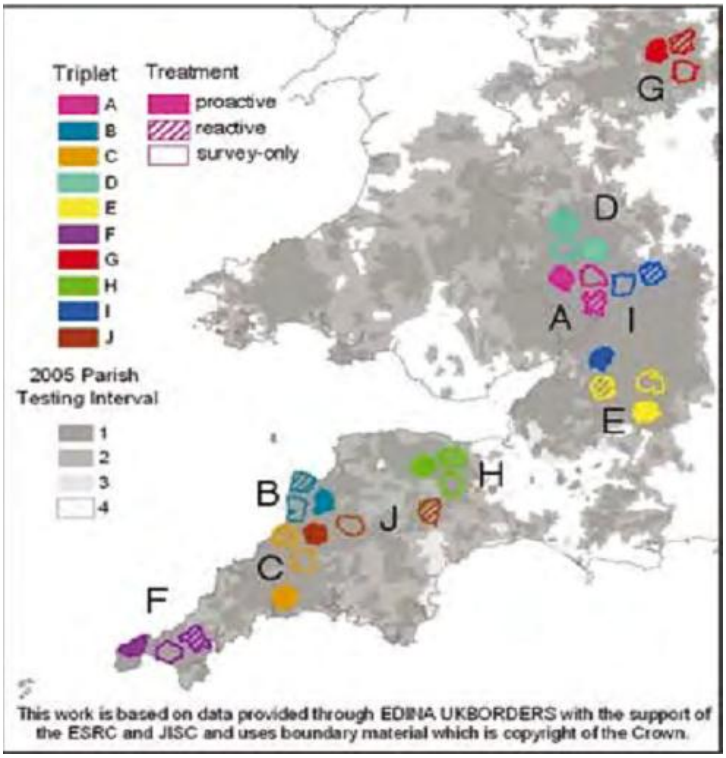

Figure 3 : Randomised Badger Culling Trial (RBCT) areas[14]

[13] Bovine TB: The Scientific Evidence, Final Report of the Independent Scientific Group on Cattle TB, June 2007, page 36

As is evident in Figure 2 the RBCT trial areas were found in South West and West England within the counties of Devon, Cornwall, Gloucestershire, Somerset, Herefordshire, Staffordhsire and Derbyshire.

Culling was conducted by trapping animals in baited cages and then shooting them, and this work was conducted by staff from the then Ministry of Agriculture, Fisheries and Food's (MAFF) Wildlife Unit (WLU). This method was employed as it was deemed to be more humane than methods such as gassing or snaring.

All badger carcases resulting from the cull were sampled, labelled and delivered to the Veterinary Laboratories Agency for post most analysis that enabled culturing and genetic typing of *M Bovis* infection when discovered.

The RBCT commenced in November 1998 and ran to October 2005 and included an annual closed season, when no culling occurred, from February to April. The trial was also disrupted by the Foot and Mouth Outbreak across the UK in 2001.

3.2 RBCT Findings

3.2.1 Preliminary findings

A preliminary analysis of the results from the RBCT were published in Nature on the 14th December 2005[15] and revealed what appeared to be contradictory findings in that they showed that badger culling could both increase and decrease Bovine TB incidence.

The data showed that **proactive culling of badgers reduced the incidence of Bovine TB by 19% within the proactive cull area, but also increased Bovine TB incidence by 29% up to a distance of 2km outside the proactive cull area**.

With regard to **reactive culling, the data revealed that this process actually led to a 27% increase in Bovine TB incidence within the reactive cull area**. This finding was less surprising as this information had come to light **in November 2003[16] when Defra had halted the reactive cull strategy as part of the RBCT**, in light of the negative impact it was having on Bovine TB incidence rates.

3.2.2 Reaction to Preliminary Findings

The reaction to these preliminary findings focussed on either efforts to better understand why culling could result in a reduction in Bovine TB incidence in some areas whilst there was an apparent simultaneous increase in other neighbouring areas

[14] Bovine TB: The Scientific Evidence, Final Report of the Independent Scientific Group on Cattle TB, June 2007, page 46

[15] C Donnelly et al., Positive and negative effects of widespread badger culling on tuberculosis in cattle, Nature, 14 December 2005

[16] Defra Press Release 457/03, Suspension of badger culling in reactive areas, 4th November 2003

or simply sought to question the validity of the RBCT findings when compared to other comparable work.

In relation to the former position, a paper published in the Journal of Applied Ecology in February 2006 and written by several members of the original Krebs Review/Report team concluded that

*"**Badger home ranges were consistently larger in culling areas. Moreover, in areas not subjected to culling, home range sizes increased with proximity to the culling area boundary**. Patterns of overlap between home ranges were also influenced by culling.*

and

*"…that **culling badgers profoundly alters their spatial organization as well as their population density. These changes have the potential to influence contact rates between cattle and badgers, both where culls occur and on adjoining land**.*

*These **results may help to explain why localized badger culling appears to have failed to control cattle TB, and should be taken into account in determining what role, if any, badger culling should play in future control strategies**."*[17]

As a counter to this position however, some **advocates of badger culling as a means to reduce Bovine TB incidence pointed to evidence that seemed contrary to the RBCT findings**.

The **most commonly quoted evidence in this context is that from the so called Four Areas Badger Culling Trial conducted In Ireland between September 1997 and August 2002 within Counties Cork, Donegal, Kilkenny and Monaghan**.

This trial, **which saw the removal of badgers by stop snare on both a proactive and reactive basis similar to that adopted by the RBCT, saw reductions in herd incidences of Bovine TB of 51%, 64%, 68% and 59% in the study areas within Counties Cork, Donegal, Kilkenny and Monaghan respectively[18].**

In considering the 'Four Areas' data, the ISG final report does question whether it is directly comparable with the RBCT data, given factors such as the apparent lower badger density within the 'Four Areas' trial, the different trapping method employed which may be more efficient but less humane, and the fact that the 'Four Areas' had substantial natural boundaries such as rivers and coastline which restricted badger movement and recolonisation.

An additional argument put forward by some badger cull advocates focussed on the number of baited traps that had been interfered with or removed as part of the RBCT.

[17] R Woodroffe et al, Effects of culling on badger Meles meles spatial organization; Implications for the control of bovine tuberculosis, Journal of Applied Ecology, February 2006, volume 43 page 1

[18] Griffin et al, The impact of badger removal on the control of tuberculosis in cattle herds in Ireland, Irish Veterinary Journal 2005, 58:629-636

A Parliamentary Question by the then Shadow Minister for Environment, Food and Rural Affairs, Owen Paterson MP, to the then Secretary of State for Environment, Food and Rural Affairs, Margaret Beckett MP, on the 8th December 2003 seeking to discover the level of trap interference during the RBCT established that:

"Interference with badger traps laid in the Randomised Badger Culling Trial is variable between operations. It is usually quite geographically localised and repetitive within a culling operational area. Management records indicate that over 116 culling operations, across 19 trial areas, between December 1998 and 10 October 2003, during which 15,666 traps were sited there were 8,981 individual occasions where a trap was interfered with, and 1,827 individual occasions when a trap was removed[19]."

On the basis of these trap interference and removal figures, which equate to 57% of traps being interfered with and 12% of traps removed between December 1998 and 10 October 2003, some critics of the RBCT and the ISG's analysis of the data have raised concerns that this interference and removal may have contributed to the spread of TB outside of cull areas identified in the RBCT analysis. This assertion is based upon the fact that there is no way of determining how many of the removed traps in particular may have contained TB infected badgers and whether these may have been released in proximity to the cull area, and what impact this may have had on spreading the disease to other badgers.

3.2.3 Final Report of the Independent Scientific Group on Cattle TB

The final analysis of the raw data from the RBCT was contained in Final Report the Independent Scientific Group on Bovine TB[20] which was presented to the then Secretary of State for Environment, Food and Rural Affairs, The Rt Hon David Milliband MP in June 2007.

In considering and analysing all of the available RBCT data in addition to other completed research on other issues associated with Bovine TB this report made the following findings:

- **Removing badgers by culling was found to disrupt their social organisation, causing remaining badgers to range more widely both inside and around the outside of culled areas**;
- Probably linked to the previous point, **the proportion of badgers infected with TB rose markedly in response to repeated culling and infections became more widely dispersed**;

[19] Parliamentary Question (No 141971) by the Shadow Secretary of the State for Environment Food and Rural Affairs, Mr Owen Paterson MP, to the Secretary of State for Environment Food and Rural Affairs, Margaret Beckett MP, 8th December 2003, Official Record, House of Commons, Session 2003-4

[20] Bovine TB: The Scientific Evidence, Final Report of the Independent Scientific Group on Cattle TB, June 2007

- **The overall incidence of confirmed TB Breakdowns in cattle was 23.2% lower inside proactively culled trial areas than inside survey-only areas**;
- **The overall incidence of confirmed TB breakdowns in cattle was 24.5% higher on land up to 2km outside proactive trial areas, than that on land neighbouring survey-only areas;**
- The overall estimate was that **incidence of confirmed TB breakdowns in cattle was 23.7% higher in reactive cull trial areas, than that inside survey only areas;**
- **In general terms proactive badger culling reduced the incidence of cattle TB inside trial areas but elevated incidence on unculled land up to 2km outside, whilst reactive culling increased the incidence of cattle TB inside trial areas;**
- The **beneficial and detrimental effects of proactive culling changed over time**, with the **detrimental effect (increases in cattle herd TB incidence) dominating initially**. **Only after the fourth proactive cull did the estimated number of breakdowns prevented by proactive culling consistently exceed the estimated number induced**, but the overall gains in terms of reduced cattle herd breakdowns were small;
- **Badger culling as conducted under the RBCT, required substantial effort by a large number of staff – proactive culling entailed over 160,000 trap nights** conducted over 4-7 years per area. Simple economic analyses reveal that **a culling policy based on cage trapping as in the RBCT would incur costs that were between four and five times higher than the economic benefits gained inside a proactively culled area of 100km²;**
- The RBCT **yielded some evidence of the transmission of *M bovis* infection from cattle to badgers**. The **majority of cattle TB testing was suspended during the Foot and Mouth outbreak in 2001 resulting in infected cattle remaining on farms and being able to transmit *M bovis* infection**. **During this time the prevalence of *M bovis* infection in badgers rose markedly and declined again after cattle testing was resumed**;
- The **risk of Bovine TB herd breakdown is multifactorial** and has been **observed to be associated with a variety of farm management, wildlife and environmental factors**. Factors amenable to management associated with herd breakdowns include cattle movements, herd contacts, housing, fertiliser usage, feeding practices and badger contact;
- The **Tuberculin skin test, which is a critical component of TB control policy in Britain, fails to identify a significant number of infected animals**. **In heavily infected herds the interferon blood test (IFN) diagnosed 27% more animals with confirmed infection** than were diagnosed by the disclosing tuberculin skin test – this has **serious implications for the persistence of the disease in infected herds, for the spread of infections within the herd and**

locally and for the spread, by cattle movement, to geographically distant parts of the country;

Building upon these findings the ISG's Final Report put forward the following conclusions and recommendations:

- Detailed **evaluation of RBCT and other scientific data highlights the limitations of badger culling as a control measure for cattle TB**. The **overall benefits of proactive culling were modes**t (representing an estimated 14 breakdowns prevented after culling 1,000km² for five years), and **were realised only after coordinated and sustained effort**. While many **other approaches to culling can be considered, available data suggest that none is likely to generate benefits substantially greater than those recorded in the RBCT, and many are likely to cause detrimental effects**. Given its **high costs and low benefits we therefore conclude that badger culling is unlikely to contribute usefully to the control of cattle TB in Britain, and recommend that TB control efforts focus on measures other than badger culling**;
- In contrast with the situation regarding badger culling, **our data and modelling suggest that substantial reductions in cattle TB incidence could be achieved by improving cattle-based control measures. Such measures include the introduction of more thorough controls on cattle movement through zoning or herd attestation, strategic use of the interferon blood test (IFN) in both routine and pre-movement testing, quarantine of purchased cattle, shorter testing intervals, careful attention to breakdowns in areas that are currently low risk, and whole-herd slaughter for chronically affected herds**;
- **Continued research will be critical to refine cattle-based TB control strategies**. Further **refinement and field experience of the interferon blood test (IFN), more detailed interrogation of existing data, particularly cattle testing and tracing data, will be of value**. The involvement of independent expert scientists, as a complement to the excellent scientific expertise already available to Defra through its Executive Agencies, will ensure the application of the most appropriate and up-to-date approaches and is likely to generate the most effective control strategies.

4 Responses to ISG report findings on the RBCT

The publication of the ISG's final report in June 2007 instigated a range of reviews and policy responses with notable contributions set out here in chronological order.

4.1 Government's Chief Scientific Adviser Review – July 2007

At the behest of the government, the Chief Scientific Adviser, Professor David King, convened a group of experts to review the ISG's final report and the data on which it

was based. This additional work was undertaken with a view towards recommending a course of action for the Government.

Professor King presented his report in July 2007[21] which focussed on the links between TB in badgers and cattle and drew the following conclusions:

- **Badgers are a clear source of infection for cattle**. Reducing the density of badgers in those areas of England where there is a significant level of TB in cattle reduces the incidence of TB in cattle in the same area;
- **Removal of badgers should take place alongside the continued application of controls on cattle**. Genuine commitment by all interested parties to the overall TB strategy is needed if TB is to be successfully controlled;
- **Removal of badgers is the best option available at the moment to reduce the reservoir of infection in wildlife. But in the longer term, alternative or additional means of controlling TB in badgers, such as vaccination, may become available**. Research into these should continue;
- **Removal of badgers should only take place in those areas of the country where there is a high and persistent incidence of TB in cattle**. It is not an appropriate measure in other areas;
- **The minimum overall area within which badger removal should take place is 100 km², although increasing the area would increase the overall benefit**;
- Where there is inaccessible land within the overall removal area, badgers should be removed on the accessible land bordering it;
- **Badger removal programmes should be sustained** (unless replaced or supplemented by alternative means of control);
- The removal process must be effectively and humanely carried out by competent operators. Removal which is improperly carried out, or which is fragmented in space or time, could cause detrimental effects on the incidence of cattle TB. Further consideration should be given to the way in which the removal process should be carried out;
- **There is some evidence of an adverse effect on the incidence of cattle TB in the area 0.5 - 1.0 km outside the removal area. This may or may not be totally related to the removal programme**, and there should be monitoring outside the removal area to detect any such effect. Measures should be taken to limit the risk of such an effect by:

(i) where possible, reducing the migration of badgers into the removal area by hard geographical boundaries such as rivers or motorways or, where these do not exist, soft boundaries (such as arable land with no cattle) which are at least 1km wide; or

[21] Bovine Tuberculosis in Cattle and Badgers, A Report by the Chief Scientific Adviser, Sir David King, submitted to Defra 30th July 2007

(ii) if immigration of badgers into the removal area cannot be prevented or sufficiently inhibited, then, subject to epidemiological findings, sustaining removal (or replacing it by or combining it with measures such as vaccination once they become available).

- **The incidence of TB in cattle in the removal areas should be monitored on an annual basis. After four years, the badger removal programme should be reviewed**. This may entail some assessment of the prevalence of TB in badgers.
- The badger population should be monitored.

Whilst praising the work of the ISG, Professor King also drew attention to areas where he and his assembled experts differed from the ISG in terms of analysis of the RBCT data with notable examples being:

- …**the ISG states that "badger culling cannot meaningfully contribute to the control of cattle TB in Britain"**. However, **the data do not support such an unqualified conclusion**.
- We agree that **the data in the ISG report demonstrate that removal gives a real reduction in the incidence of cattle TB within the removal area**. However, **we consider that the ISG's view that this benefit was largely offset by the increase in incidence outside the removal area is unsound and should be subject to further spatial and temporal analysis**.

Professor King's report concluded with the following recommendation to the government:

- **In our view a programme for the removal of badgers could make a significant contribution to the control of cattle TB in those areas of England where there is a high and persistent incidence of TB in cattle, provided removal takes places alongside an effective programme of cattle controls**.

This recommendation was clearly at odds with the recommendation put forward within the ISG Final Report that badger culling was unlikely to contribute to the control of cattle TB in Britain. This very clear difference of opinion became clear when Professor John Bourne, the Chairman of the ISG, appeared before the Environment, Food and Rural Affairs Select Committee on the 25th October 2007. When asked to comment on Professor King's report Professor Bourne revealed that

*"I think there is a real difficulty here, (David), with this report in that it was **clearly hastily written and because of that it is very superficial; it is also very selective**. What is so **important is that you do not just cherry pick bits of data from the report but that you look at the totality of the data that we presented as a result of gathering this over 10 years to draw your conclusions**. One can select bits and*

pieces of data as they have done here, but it gives a very superficial sound bite, which is totally inappropriate to considering the data in its totality.[22]"

4.2 Environment, Food and Rural Affairs Select Committee Inquiry

The differing views on the issue of badger culling between the reports prepared by the ISG and Professor King prompted the Environment, Food and Rural Affairs Select Committee at Westminster to conduct an inquiry with a view to better understand the work completed to date as well as seeking to plot a way forward.

The Inquiry took evidence from a range of interested parties and stakeholders that included Professor King and Professor Bourne and other colleagues from the ISG.

The Select Committee published their Inquiry report in February 2008[23] and made the following general conclusions:

- The **Government must show its commitment to finding a way to ease the grip that cattle TB has upon the country**. To do this, its policy must be to **reverse in the short term the rising level of incidence of the disease with a long term goal of eradication through the use of vaccines**. (Paragraph 192)
- The **Government must continue to fund research into vaccines and the efficacy of biosecurity measures**. It must also continue not only to fund the routine testing of cattle, but must examine carefully the benefits of increasing the frequency of testing and the introduction of the parallel use of gamma interferon testing alongside the tuberculin skin test.
- More frequent and thorough testing will lead in the short term to an increase in the number of cattle reactors that are found and slaughtered.
- The **Government must re-consider the levels of compensation currently paid to farmers and must ensure that it does not shirk its responsibility to pay farmers a fair price for their cattle**.
- The Government cannot countenance the reduction of its spending on the disease at this stage given the **advice from the ISG that current cattle controls are not stringent enough.** Defra must ensure that a cost benefit analysis (including farmers' costs and benefits) is prepared of the cattle-based measures recommended by the ISG and its agencies to ensure that it is able to plan for the proper levels of expenditure needed to fulfil its cattle TB policy.
- To match the Government's commitment to fight the disease, **it is right that farmers may be asked to increase their own spending on pre- and post-**

[22] Oral evidence session 75, Professor John Bourne CBE, former Chairman, Professor Christl Donnelly, Environment, Food and Rural Affairs Select Committee Inquiry, 24th October 2007

[23] Badgers and cattle TB: the final report of the Independent Scientific Group on Cattle TB, Fourth Report of Session 2007–08, Environment, Food and Rural Affairs Committee, House of Commons, 27th February 2008

movement testing and on-farm biosecurity measures. We acknowledge that this could mean an additional financial burden for farmers, as well as an unwelcome increase in the time and effort already spent by farmers and vets on the administrative burden demanded by the testing regime. The farming industry is already suffering from the financial and emotional consequences of the steady increase in the number of cattle TB breakdowns, but it **must work together with the Government, veterinarians and scientists to monitor the outcome of measures taken to tackle the disease if we are to plug the fundamental gaps in our understanding of how cattle TB is transmitted**.

On the specific issue of badger culling the committee concluded that;

- We have **recommended that the culling of badgers in high risk areas should in principle be licensed under the Protection of Badgers Act to counter the spread of cattle TB provided that the licensee is able to fulfil conditions based on the findings of the ISG Report**. The Government must provide a practical framework of guidelines for Natural England as the licensing authority. The **farming industry must accept that the Government is unlikely to fund the culling of badgers as a method of tackling the wildlife reservoir**. Whilst the farming industry is likely to have to bear the costs of any cull if it chooses to go down that road, **farmers must also accept that culling, in accordance with the conditions agreed between the ISG and Sir David King, cannot become the cornerstone of a Government TB policy as it would not be suitable as a control method in all areas**.

As well as putting on record that

- The Committee recognises that **under certain well-defined circumstances it is possible that culling could make a contribution towards the reduction in incidence of cattle TB in hot spot areas**. However, as there is a **significant risk that any patchy, disorganised or short-term culling could make matters worse**, the Committee could only recommend the licensed culling of badgers under section 10 of the Protection of Badgers Act 1992 if the applicants can **demonstrate that culling would be carried out in accordance with the conditions agreed between the ISG and Sir David King, which indicated that there might be an overall beneficial effect**. These were that **culling should: be done competently and efficiently; be coordinated; cover as large an area as possible (265km² or more is the minimum needed to be 95% confident of an overall beneficial effect); be sustained for at least four years; and be in areas which have "hard" or "soft" boundaries where possible**.