

<i>On Behalf of</i>	:	<i>Claimant</i>
<i>Witness</i>	:	<i>Rosemary Woodroffe</i>
<i>No. of Statement</i>	:	<i>1</i>
<i>Dated</i>	:	<i>11 March 2010</i>

**IN THE MATTER OF A CLAIM**  
**IN THE HIGH COURT OF JUSTICE**  
**ADMINISTRATIVE COURT**  
**CARDIFF**

**CO/15769/2009**

**B E T W E E N:**

**Badger Trust**

**Claimant**

**and**

**The Welsh Ministers**

**Defendant**

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**First Witness Statement of Rosemary Woodroffe**

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I, ROSEMARY WOODROFFE of the Institute of Zoology, Regent's Park, London NW1 4RY **WILL SAY** as follows:

**Introduction**

1. I am a Senior Research Fellow at the Institute of Zoology, Zoological Society of London, and a former member of the Independent Scientific Group on Cattle TB (ISG). The ISG was established in 1997 by MAFF (the Ministry of Agriculture, Fisheries and Food) to advise Ministers on implementation of the Krebs Report on bovine TB in cattle and badgers. The ISG was dissolved in 2007 after submitting its final report<sup>1</sup>. Before formation of the ISG, I was an advisor to the Krebs Committee<sup>2</sup>.
2. My primary role within the ISG was to oversee the collection, analysis and interpretation of data relating to badger ecology and the dynamics and epidemiology of *Mycobacterium bovis* infection in badgers, as part of the Randomised Badger Culling Trial (RBCT). I also played a lead role in preparing ISG papers for publication in the

peer-reviewed literature and am an author on all such ISG publications. Since the ISG was dissolved, I have continued to help interpret data emanating from RBCT areas, and am a co-author on two subsequent papers reporting the incidence of cattle TB following the cessation of badger culling<sup>3,4</sup>.

3. I received my D.Phil. from the University of Oxford in 1992, specialising in badger ecology and behaviour. Since then, much of my work has focused on the transmission of infectious disease between wildlife and domestic animals. I was formerly a Lecturer in Ecology and Epidemiology at the University of Warwick, and then Professor of Conservation Biology at the University of California, Davis. At Davis, I was affiliated with the Wildlife Health Centre and taught courses in the ecology of wildlife disease in conjunction with the School of Veterinary Medicine. I am a member of the Wildlife Health Specialist Group of the World Conservation Union.
4. I have been asked by the Badger Trust to provide this witness statement in response to the evidence served on them in the course of these judicial review proceedings.
5. In our final report, the ISG concluded, after careful evaluation of our own and others' data, that badger culling could make no meaningful contribution to cattle TB control in Britain<sup>1</sup>. Publications produced subsequently, based on continued monitoring of RBCT areas, have not altered this conclusion<sup>3,4</sup>. I note that the scientific reports commissioned by the Welsh Assembly Government provide no additional empirical data on this issue, and none of these reports indicates an expectation of substantial reductions in cattle TB incidence to be achieved by non-selective badger culling.
6. As a former member of the ISG, and a resident of a TB hotspot, I am acutely aware of the impact that TB has on the farming industry and on farming families' livelihoods. The ISG recommended that Defra focus on control methods other than badger culling because we considered this to be the approach most likely to reduce the impact of cattle TB on farmers.
7. The results of the RBCT are critical to the evaluation of badger culling as a tool to "*eradicate or substantially reduce*" cattle TB in Wales, and it is worth briefly summarising them here.

- The incidence of confirmed<sup>a</sup> cattle TB in ten 100km<sup>2</sup> areas which received widespread badger culling was lower than that in ten matched areas which received no culling<sup>3,4,5,6</sup>.
- However, cattle TB incidence was higher on uncultured lands neighbouring the culled areas, than on lands neighbouring the no-culling areas<sup>3,4,5,6</sup>.
- There were no effects on unconfirmed<sup>b</sup> breakdowns<sup>1</sup>.
- Repeated culling caused the prevalence of infection among badgers to rise over time<sup>7</sup>, and this almost certainly undermined the benefits in terms of reduced cattle TB.
- When considering the entire area affected (culled and neighbouring lands), widespread culling achieved a modest reduction in cattle TB relative to no-culling, but did not cause an absolute reduction<sup>3,c</sup>; that is, culling slowed the rate of increase in cattle TB but did not cause TB to decline.
- The financial costs of widespread culling exceeded the benefits by a factor of 3.5<sup>4</sup>.
- An alternative approach involving localised culling of badgers increased cattle TB incidence<sup>8</sup>.
- Badger culling appeared to have limited benefits - or to cause detrimental effects - because it prompted changes in badger behaviour which increased disease transmission<sup>9</sup>; this process is termed “perturbation”.

A thorough evaluation of potential culling methods led the ISG to conclude that “*We are unable to conceive of a system of culling, other than the systematic elimination, or virtual elimination, of badgers over very extensive areas, that would avoid the serious adverse consequences of perturbation*”<sup>1</sup>.

8. Having read the witness statement provided by Dr Christianne Glossop, Chief Veterinary Officer for Wales, and supporting documentation, I have noted several serious errors of interpretation of the scientific evidence, outlined below. I also note that Dr Glossop’s Programme Board appears not to have included a scientist accustomed to the analysis and interpretation of epidemiological data (Tab A7 - CG Witness Statement paragraph 30). These two points may be related to one another.

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<sup>a</sup>TB incidents in which slaughtered cattle are subsequently confirmed to have been infected.

<sup>b</sup>TB incidents in which cattle fail the skin test and so are slaughtered, but are not subsequently confirmed to have been infected.

<sup>c</sup>These data are in Tables S1 and S2 of Jenkins *et al.* (2008).

## Lack of understanding of RBCT findings

9. Section 6.3.4 of the document "*Wales bovine TB eradication programme - control strategies in an intensive action pilot area*" (Exhibit CG1 pgs 23-61) summarises the RBCT results from Jenkins *et al.* (2008)<sup>3</sup> as "*an overall 9% reduction in the incidence of cattle herd breakdowns*". Section 9.2.3 of the same document notes that "*The Programme Board agreed that against the backdrop of an increasing disease incidence, an overall 9% reduction as achieved post culling in the RBCT was a significant achievement that should not be undervalued*".
10. This statement demonstrates a fundamental misunderstanding of RBCT results. As mentioned above, the RBCT did not involve a before-and-after comparison, producing a "*9% reduction... post culling*" to be compared with "*increasing disease incidence*" elsewhere. Rather, the RBCT involved a side-by-side comparison of culled and un-culled areas monitored over the same time periods. The incidence of cattle TB in and around culled areas was lower than that in and around un-culled areas (a relative reduction), but both types of area experienced absolute increases in TB over time. Widespread culling in the RBCT did not cause cattle TB to decline, it simply slowed the rate of increase.
11. In paragraph 56 of Dr Glossop's witness statement, she takes a view that "*the information provided by the 2010 Jenkins paper differs little from that provided by the 2008 Jenkins paper*". Of course, were the differences indeed so trivial, the second paper would never have been accepted by a high-profile scientific journal.
12. At the time of the first paper in 2008<sup>3</sup>, improved benefits had become apparent after the cessation of culling and, although we cautioned that these benefits were expected to dissipate over time, we could not predict how long this would take. There were therefore some grounds for optimism that the benefits might continue. However, the subsequent paper<sup>4</sup> showed that these benefits were short-lived. This evidence that badger culling provides only modest, short-term benefits is highly relevant in evaluating it as a tool to eradicate or substantially reduce the incidence of cattle TB. Although this evidence had not yet been peer-reviewed at the time when officials of the Welsh Assembly Government were first made aware of it (at a Defra meeting on 22nd September 2009), much of the dataset and all of the analysis methods had

already been peer-reviewed and published in a series of papers, including some in the world's premier scientific journals<sup>3,4,5,6,8</sup>. Hence, the findings should not have been considered unsound or *ad hoc*.

13. Dr Glossop's team appear to be unaware that both Jenkins papers<sup>3,4</sup> are concerned exclusively with confirmed cattle herd breakdowns. This is because proactive badger culling had no effect on the incidence of unconfirmed breakdowns<sup>1</sup>. Breakdowns which are unconfirmed nevertheless prompt cattle slaughter, imposition of movement restrictions, and repeated testing, and hence have policy relevance. Since about one-third of breakdowns are unconfirmed, the effects reported in the Jenkins *et al.* papers (such as the 9% figure cited by Dr Glossop) over-estimate the likely reductions in all (confirmed and unconfirmed) breakdowns by about one third (e.g. a 9% reduction in confirmed breakdowns would represent a roughly 6% reduction in all breakdowns).
14. Dr Glossop states, in paragraph 49 of her witness statement, that "*it is highly possible that the benefits of [RBCT] culling... would have been greater if the foot and mouth disease epidemic had not intervened*". There is no evidence to support this claim; the ISG pointed out that the foot and mouth disease epidemic "*did not affect the trial conclusions*"<sup>1</sup>. Of the 10 RBCT triplets, seven were recruited before the start of the foot and mouth disease epidemic, and three afterwards; the beneficial and detrimental effects were consistent across these two types of triplet<sup>6</sup>.

#### **Flawed evaluation of the outcomes of culling**

15. The proposed culling area is a pilot project, and Dr Glossop's Programme Board note that "*Monitoring and evaluation of the IAPA will be essential in assessing this policy for further rollout in endemic areas*" (Section 9.3, Exhibit CG1 pg 51). They therefore state that "*...the level of bovine TB infection within the cattle population... must be monitored by evaluating a range of parameters both within the IAPA and on surrounding land*" (Section 9.3, CG1 pg 51). Such a monitoring programme risks systematically over-estimating any benefits of badger culling. This is because, as shown in the RBCT, badger culling increases the incidence of cattle TB on "*surrounding land*"<sup>6</sup>. Hence, any comparison between TB incidence "*within the IAPA and on surrounding land*" would involve comparing an area where incidence may be somewhat reduced, with an area where it may be somewhat increased, exaggerating any benefits.

16. In this context, I note that the Countryside Council for Wales (the only statutory consultee under the Animal Health Act 1981) advised the Minister that “*advice should be sought on whether statistically useful information can be collected to determine whether the desired improvement on the results of the RBCT have been achieved.*” (CG1 Pg 437). Dr Glossop has provided no evidence that such advice was sought.

**Incomplete evaluation of cattle controls alone (as an alternative to badger culling)**

17. The ISG concluded that “*Scientific findings indicate that the rising incidence of disease can be reversed, and geographical spread contained, by the rigid application of cattle-based control measures alone*”<sup>1</sup>. However, the cattle-based measures identified at paragraph 41 of Dr Glossop’s witness statement are less stringent than those recommended by the ISG<sup>1</sup>. For example, there is no commitment to wider use of the more sensitive IFN- $\gamma$  cattle test, and no plan to control the movements of cattle within, into, or out of the IAPA based on TB risk.
18. In paragraph 49 of her witness statement, Dr Glossop observes that, while the benefits of RBCT badger culling were “*relatively modest*”, the Minister “*recognised how such results could be enhanced through application of a more comprehensive approach aimed at tackling all sources of infection together*”. However, no scientific work appears to have been commissioned to investigate the likely benefits of improved cattle controls, either alone or in combination with badger culling. This is remarkable when the model used to evaluate various forms of badger management also included elements of cattle control (e.g. cattle testing strategies, cattle movements) and could have been analysed to investigate their likely effects.
19. To illustrate, in Exhibit CG1 (pages 162-166) the authors of the modelling study analyse the expected effects of combining badger culling with pre-movement testing of cattle. Further analyses of this kind could have been highly informative. Failure to exploit this modelling opportunity represents an incomplete assessment of both the likely marginal benefits of badger culling, and the potential of cattle-based controls alone as a potential alternative.

## Inadequate comparison of culling with vaccination

20. In her witness statement, Dr Glossop dismisses vaccination of badgers as an alternative to culling, primarily because “*vaccination of badgers does not address existing infection in badgers*” (paragraph 34), but also because “*delivering a BCG vaccine to badgers is problematic*” (paragraph 33 (2)), because “*the level of benefits, in terms of reduction of cattle tuberculosis and the timescale to realise these benefits is not known*” (paragraph 33 (2)), and because vaccination “*can contribute to an eradication programme... [but] alone cannot achieve eradication*” (paragraph 32 (2)). I address each of these points in turn.
21. While vaccination can only prevent new infections, not remove existing infection, about a quarter of adult badgers die each year. This means that repeated administration of vaccine over a few years is expected to achieve an increasing proportion of protected animals and hence a declining level of infection. In contrast, repeated badger culling increased the prevalence of infection among badgers in the RBCT<sup>7,10</sup> and caused the disease to spread in space<sup>11</sup>, undermining the benefits for cattle. Vaccination is thus more likely to contribute to disease eradication than is culling.
22. Dr Glossop does not elaborate on why delivery of BCG to badgers is “*problematic*”. Although an oral formulation is not expected until 2014 (paragraph 33(2)), I note that the proven method of vaccination by injection is estimated to be cheaper than culling (CG1 pg 43).
23. Although in Dr Glossop’s witness statement she observes that “*the level of benefits [from vaccination], in terms of reduction of cattle tuberculosis and the timescale to realise these benefits is not known*”, a summary point in her advice to the Minister claims that vaccination is “*Likely to take longer for benefits to the industry and taxpayer*”. This latter statement appears to lack a scientific basis; modelling work which compared vaccination with culling led to a conclusion that “*...the differences between those... strategies in terms of CHB [cattle herd breakdown] rates was minimal and it is doubtful whether any such differences would be detectable in the field*” (CG1 Pg 264). It is also worth noting, in reference to potential benefits to “*the taxpayer*”, that multiple published analyses<sup>1,4,12</sup> show that badger culling entails no net benefits (but substantial costs) for the taxpayer.

24. It is inconsistent to dismiss vaccination on the grounds that “*it alone cannot achieve eradication*” when Dr Glossop has repeatedly emphasised (e.g. in paragraph 41 of her witness statement) that any badger management (such as culling) could only be effective as part of a package of measures.

**Summary**

25. In summary, officials of the Welsh Assembly Government appear to have made multiple errors in evaluating scientific evidence to inform policy. Hence, while the Minister may have become “*satisfied that... the destruction of wild badgers in Wales is necessary in order to eliminate or substantially reduce the incidence of tuberculosis in cattle in Wales*”, in my opinion her position is based upon incomplete and erroneous interpretation of the evidence available.

I, Rosemary Woodroffe, believe that the facts stated in this witness statement are true.



**Signed .....**

**Dated.....12 March 2010**

## Literature Cited

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- <sup>2</sup> Krebs, J. R. *et al.* *Bovine tuberculosis in cattle and badgers*. (H.M.S.O., 1997).
- <sup>3</sup> Jenkins, H. E., Woodroffe, R. & Donnelly, C. A. The effects of annual widespread badger culls on cattle tuberculosis following the cessation of culling. *International Journal of Infectious Disease* **12**, 457-465 (2008).
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- <sup>8</sup> Donnelly, C. A. *et al.* Impact of localized badger culling on TB incidence in British cattle. *Nature* **426**, 834-837 (2003).
- <sup>9</sup> Woodroffe, R. *et al.* Effects of culling on badger (*Meles meles*) spatial organization: implications for the control of bovine tuberculosis. *Journal of Applied Ecology* **43**, 1-10 (2006).
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- <sup>12</sup> Wilkinson, D. *et al.* Cost-benefit analysis model of badger (*Meles meles*) culling to reduce cattle herd tuberculosis breakdowns, with particular reference to badger perturbation. *Journal of Wildlife Diseases* **45**, 1062-1088 (2009).