

## Science Advisory Council/Bovine Tuberculosis Science Advisory Body Joint Group on Defra's Bovine TB consultation

Advice based on the consultation questions.

### General comments

The Group recognised that Defra's overall goal is to reduce the incidence of bTB in cattle within endemic areas, and to stop any further expansion of these areas. The proposed options are an important part of a package of measures to achieve this goal.

The Group agrees that control of bTB in cattle can only be achieved by a multi-faceted approach, and that this approach must include tackling the disease in badgers in addition to increasing current cattle controls.

While there is evidence to support many of the points in the consultation, for some issues there is insufficient evidence, or the evidence is not directly applicable to what is being proposed and hence some extrapolations are necessary. Therefore we have in places offered expert opinion based on what we feel to be reasonable assumptions from an understanding of disease processes.

Given the inevitable uncertainties in the science and the differences between the proposed options and the trials that provided the evidence, we advise that **monitoring the implementation** of the chosen option and **measuring its effect** are the key to ensuring that the policy remains welfare friendly and science led.

It is also important that appropriate data are collected throughout any intervention so that a thorough evaluation can be carried out in four year's time.

### Advice on the consultation questions

#### **Question 1: What is your scientific advice on the evidence behind the options, costs and assumptions made in the Impact Assessment?**

The assumptions made in the Impact Assessment on culling are derived mainly from the findings of the Randomised Badger Culling Trial (RBCT), or are estimates where direct evidence is absent; however, we cannot say that any other set of assumptions would have been any more or less valid.

Recent laboratory and field-based studies have shown that vaccination reduces the amount of bTB lesions in infected badgers and lowers the percentage of badgers testing positive to a serological test. However whether the infectivity of vaccinated badgers is reduced has not been established, and there is no clear demonstration at the present time that vaccination will reduce the incidence of bTB in a badger

population or in cattle. The assumptions on the impact of vaccination on the epidemiology of bTB are based on reasonable extrapolation from its effect on disease in badgers.

It follows that the option 6 illustrated in the impact assessment (industry led cull and vaccination) is a combination of two options, neither of which have been attempted or evaluated previously. It is important therefore that appropriate data are collected if the policy is to be evaluated at key stages and that lessons to be learnt with respect to future strategies for controlling and reducing the incidence of bTB

**Question 2: What is your scientific advice on the selection of option 6 as the preferred option?**

The financial data presented in the Impact Assessment do not obviously point to the selection of Option 6 (industry led cull and vaccination). Whilst Option 6 shows the highest net benefit to the Government/taxpayer, it is Option 4 that offers the highest net benefit overall according to the Impact Assessment. Furthermore, of the two options that predict an overall net benefit (and hence could be considered as acceptable in financial terms), it is Option 4 that represents the least cost to landowners and hence is likely to carry more incentive for them to adopt.

Alternatively a combination of options 4 (landowner-led culling) and 3 (centrally-led, or at least centrally-financed, ring vaccination) may be more effective at reducing disease, since modelling studies suggest that ring vaccination will reduce the number of herd breakdowns. This is discussed in more detail under question 6 and 7.

Given the dependence of the Impact Assessment on the assumptions adopted, it requires more detailed consideration to reflect how sensitive its outcomes and conclusions are to variation in the parameters.

The use of free-shooting in addition to, or instead of, cage-trapping could affect the expected reduction in badger numbers. The basis of the costing of £200/km<sup>2</sup> for free shooting was seen as somewhat speculative, and the basis for assuming a 2/3:1/3 proportion of shooting to trapping was unclear.

**Question 3: What is your scientific advice on whether this approach, of issuing licences to farmers/landowners, is the most appropriate way to operate a badger control policy?**

This question can be informed by social science since it touches on the motivation and incentives (or lack of) which could affect participation in culling as proposed in the consultation. There are risks with this approach because control would be devolved to a local level while the policy needs to be monitored centrally to ensure satisfactory compliance.

Centralised management either by government or a non-governmental organisation was felt to be necessary for a comprehensive programme, at least for vaccination where the benefits to landowners are less evident, and also to ensure consistent, systematic and co-ordinated action across a control area.

On the other hand, social science evidence from surveys of technology adoption and farmer response to policy suggests that a high level of involvement and engagement in policy and innovation contribute to success. This would support a farmer/landowner led approach.

Landowners may differ in their commitment to culling and the way in which culling is pursued. This could result in some holdings being more effectively culled than others, in which case perturbation could undermine some of the positive effects of culling. Careful monitoring will be necessary to ensure that all of the landowners within a given target area who sign up to a licence agreement carry out control measures effectively.

**Question 4: What is your scientific advice on the proposed licensing criteria for culling and vaccination?**

*i) The area has high and persistent levels of TB in cattle*

The Group felt that the requirement for a “recognised established reservoir of the disease in badgers” is potentially a difficult criterion to meet if temporal and spatial evidence of TB in badgers, and of onward transmission to cattle is needed to justify a cull. Outside of Woodchester Park and the RBCT areas, little is known about the incidence of TB in badgers or indeed about the density of badgers. It is therefore unclear what evidence applicants would need to present to satisfy this criterion and the Group suggests that high badger sett density in an area of high cattle bTB incidence should be used as a proxy for a reservoir of infection.

*ii) The area is at least 150km<sup>2</sup> in size*

The Group agreed that 150km<sup>2</sup> is the logical minimum size for a culling area in order to have a reasonably high level of confidence that culling will achieve a net beneficial effect. The figure of 150km<sup>2</sup> is based on available RBCT data and modelling.

*iii) There is land access for culling for over 70% of the area*

The 70% figure is based on the average access levels attained in the RBCT, and therefore represents the basis on which the RBCT findings might be extended to the proposed culling policy. There is no evidence available on the impacts of culling for areas where more or less than 70% of the land was accessible. However, it is reasonable to assume that greater than 70% access would be more beneficial.

*iv) Where possible, the area will have boundaries or buffers to mitigate any possible negative effects in neighbouring areas caused by perturbation of badgers' social groups*

This criterion is justified by evidence that the perturbation effect on cattle herd breakdowns is due to the extended ranging behaviour of badgers following culling.

- v) *Culling will be carried out effectively and humanely by competent operators. Culling will be permitted by cage-trapping and shooting, and shooting free-ranging badgers*

The group discussed under this section the potential impact of the organisation and timing of a cull within a licensed area on its effectiveness. The issue of simultaneous culling was explored in detail by discussing the Woodroffe 2006 paper which described the adverse effects that four non-simultaneous culls had on bTB prevalence in badgers in the RBCT (and it was noted they were all secondary 'follow-up' culls, not the initial culls undertaken when each proactive area was first commenced). Evidence was also provided by Defra on the variation and practical challenges in how each of these four non-simultaneous culls (so-called 'sector culls') were carried out.

Two differences were noted in how these culls were carried out. First, the total duration of the sector culls in the RBCT was much longer than for the simultaneous culls (all proactive areas were culled in eight almost consecutive nights in the simultaneous culls, compared with each sector being culled over eight almost consecutive nights for the non-simultaneous culls but culling in different sectors being up to two to six months apart). Secondly, the timing of the two types of culling were markedly different; non-simultaneous culls took place at least in part during the winter, compared with simultaneous culls which mostly took place in the summer and autumn). Some of the sector culls also had a large amount of interference from animal rights activists. The Group advised that the month of the cull should be added to the Woodroffe et al. 2006 analysis to see if that accounted for some of the difference as culling during winter is likely to be less effective.

Whilst the only evidence available on the beneficial effects of culling relates to when it was carried out simultaneously (i.e. over 8-11 nights in the RBCT), it was agreed that one could not use the four occasions (out of a total of 51 operations) when it was carried out as 'sector-based' as definitive evidence that non-simultaneous culling would not be effective under any circumstances, given the potential confounding factors outlined above.

There is little useful data on the issue of what time period should be considered as "simultaneous". The Group advised that if culling was carried out in a period of up to 6 weeks (although preferably less), that is likely to reduce the adverse effects of non-simultaneous culling; this advice is based on opinion and not on evidence. The longer the period that culling is carried out in, the less confident one can be that the deleterious effects seen with non-simultaneous culling as carried out in the RBCT will be minimized.

June to October was felt to be the best time to carry out culling based on knowledge of badger behaviour. However, the Group advised that Fera's data from Woodchester Park on the effect of time of year on trapping success should also be considered.

Another possible implementation would be an intensive cull followed by a low level "gamekeeper" approach thereafter. As long as the majority of animals were removed

by the intensive cull. The Group felt that this approach would be appropriate and logical if the aim is to reduce badger numbers as low as possible.

On the issue of humaneness, there is extensive evidence that shooting cage-trapped badgers is humane, provided operators demonstrate that they have the appropriate equipment and training to trap and shoot badgers appropriately.

There is no evidence on the effectiveness or humaneness of free shooting of badgers as a culling method, although there is evidence relating to other species. The Game Conservancy Trust's opinion emphasises the necessity for shooting to be undertaken by formally qualified personnel, given the precision at distance which must be achieved for an effective and humane kill (individuals with a standard firearms licence are unlikely to be sufficient).

*vi) A commitment to sustaining culling over the area at least annually for a period of at least 4 years*

The Group agreed that, based on the evidence from the RBCT, sustained culling is necessary to see a reduction in the incidence of bTB in cattle. Since some landowners may withdraw due to moving away, death, giving up farming as a profession, or disenchantment with the results achieved. Maintaining enrolment will be an important issue, requiring continued oversight and monitoring.

*vii) Culling will achieve badger densities low enough to reduce TB transmission, but not lead to local extinction*

The aim of reducing badger numbers by at least 70% is based on the estimated population reduction achieved in the RBCT (although this number is an overall estimate and there was variation between proactively culled areas). There is no empirical evidence of the effect on herd breakdowns of reducing numbers by more or less than 70%. Logic suggests that reduction by more than 70% should increase the beneficial effect. It is impossible to predict the effect of reducing numbers by less than 70% since this might (or might not) increase perturbation. However, this issue is of limited practical significance since it will probably not be possible to determine what percentage of the badger population has been culled.

The criterion of reducing badger density to a level low enough to reduce TB transmission is problematic since (a) it is unclear how badger density would be monitored and (b) there are no data relating badger densities to TB transmission rates.

On the issue of local extinction, repopulation following complete clearance of badgers from a single area (Thornbury) took a long time (~10 years). However, this recovery was characterised by a rapid initial partial re-population through immigration, followed by a slower increase through breeding. Therefore, given that immigration from nearby areas occurs, and given too that culling is unlikely to be 100% effective, and land access for culling over an prescribed area will be less than 100%, local extinction would seem not be a significant risk. The risk of local extinction will also be affected by the size of the area and the presence of natural

barriers. There are no scientific data available to permit realistic estimates of the population density required to maintain a population of badgers.

*viii) A closed season to protect dependent cubs will operate during late winter/early spring*

If the goal is to reduce badger numbers, a closed season is not the most logical course of action. However, under The Protection of Badgers Act (1992) it is an offence to cruelly ill-treat a badger and Defra has been advised that killing lactating mothers on whom cubs are dependant or exposing trapped badgers to excessively inclement weather conditions could be deemed cruel ill-treatment.

*ix) Arrangements are in place for carcasses to be removed in accordance with legal requirements for animal by-products*

The costs for bio-secure disposal of carcasses in line with Animal By-Products regulations could be a significant cost; it is suggested that the estimate of £20 per carcass is too low. There is no particular incentive for farmers to meet this requirement as they gain no obvious benefit from the cost incurred, and so very close monitoring will be necessary to ensure that carcasses are disposed of properly.

*x) Culling will be coordinated locally across the area covered by the licence*

The Group felt that this is a key issue and ideally culling should be as described under criterion v, with the culling period extended to no longer than 4-6 weeks.

*xi) The role of vaccination in reducing the perturbation effects from culling has been fully considered*

It is anticipated that the perturbation effect represents a risk of increasing the incidence of bTB on cattle farms that are inside culling areas but that opt out from culling, though no data exist for this situation and the size of the un-culled area would clearly be a factor. There are no scientific data on the effect of badger vaccination, either in isolation or in combination with culling, on cattle herd breakdowns. However, if vaccination prevents transmission in badgers (of which there is scientific expectation) then badger vaccination might ameliorate perturbation effects. If ring vaccination were to be attempted it would be preferable for the landowners (on whose land vaccination will take place) to be included in the management group.

*xii) Before a cull begins there is comprehensive awareness and compliance with existing TB control measures*

The Group felt that this is important and will need to be achieved by Government-led education as well as by veterinarians informing their clients.

**Question 5: What is your scientific advice on whether the proposed methods of culling are effective and humane?**

There is a large body of evidence available on shooting cage-trapped badgers but no evidence on the effectiveness or humaneness of shooting free-ranging badgers. Evidence from shooting free-ranging deer and lamping foxes is not necessarily transferable to badgers. The skill of the marksmen shooting free ranging badgers is crucial and a licence or qualification (such as the deer stalking qualification, Deer Stalking Certificate Level 1 (DSC1)) may be essential to ensure a basic skill level.

Live-trapping of badgers, using the procedure adopted in the RBCT, has been shown to be humane. However, the humaneness of live-trapping depends critically on the design of the traps and on how often they are inspected. If landowners are to provide traps themselves, the precise design of these will have to be specified and monitoring will be needed to ensure that this specification is adhered to. Detailed trapping protocols such as those used in the RBCT will also need to be provided and, again, monitoring will be needed to ensure that these are adhered to. We have noted the recommendation to monitor the humaneness of killing trapped badgers using frangible bullets.

**Question 6: What is your scientific advice on the proposed use of vaccination, particularly its focus on mitigating the perturbation effects of culling? and Question 7: In your scientific opinion should anything further be done to encourage the use of vaccination?**

A recent study has demonstrated that the injectable badger vaccine reduces the severity of lesions in captive badgers and reduces the proportion of badgers testing positive to a serological test in the wild. From this it can be expected that the infectivity of badgers is reduced and in turn, that this is likely to reduce transmission to cattle. However, there is no direct evidence of the impact of a badger vaccine on cattle TB incidence. It is also unlikely that any use of vaccination as outlined in the consultation will allow the gathering and analysis of data to assess effectiveness.

As the estimated cost of vaccinating badgers is comparable to the cost of trapping and shooting them, and the benefits to landowners are highly uncertain there is little apparent financial incentive for them to choose to vaccinate. It may therefore be unrealistic to expect many landowners to opt for vaccination. On the other hand it would seem in the interest of more effective bTB control that vaccination should be undertaken, particularly in attempting to mitigate the negative effects of badger perturbation. Therefore the Group felt that vaccination should be encouraged and that more should be done to show farmers that vaccination could be used in the leading edge of the epidemic or in combination with culling.

If option 6 becomes policy the Group advises that preference could be given to licence applications that include a commitment to vaccination in the area that is not covered by culling.

Vaccination may have a role in combination with culling to mitigate the perturbation effect on cattle herd breakdowns. However, perturbation effects are manifest soon

after culling whereas vaccination will only slowly reduce the incidence of infected badgers. Therefore, the earlier vaccination begins the more effective it is likely to be in mitigating perturbation. In particular, badger vaccination in the area surrounding a culling programme ('ring vaccination') is believed to offer benefits in terms of a reduction in herd breakdowns caused by perturbation. However, there is no financial incentive for farmers inside the culled area to pay for this, while the Impact Assessment estimates the financial benefits to those cattle farmers in the surrounding areas as not being sufficient to cover their costs. Because Defra's preferred option is for farmers to undertake vaccination along with the culling as part of the overall control package, consideration should be given to the Government carrying the cost of such vaccination; according to the data given in the Impact Assessment this cost could be covered and still leave a net monetary gain to the public purse.

The Group had concerns about the ease with which landowners will be able to vaccinate a high proportion of badgers. This is because trapped and vaccinated badgers will be re-released, they will be free to enter traps again on subsequent nights and thus interfere with the trapping of new animals. (In the RBCT this could not happen because trapped individuals were removed from the population.) For these reasons, it may be unrealistic to expect many landowners to opt for vaccination, or to expect those that do to achieve the 70% trapping success rate thought to have been achieved in the RBCT.

#### **Question 8: What is your scientific advice on the proposals for monitoring?**

The Group felt that successful monitoring is vital to ensure that the assumptions and extrapolations in the consultation are achievable in the field and therefore advises that an effective and well designed monitoring programme is implemented. As this will not be a scientific trial, monitoring the effects may not be able to conclusively demonstrate that the policy fulfils its objectives.

We advise that effective monitoring and evaluation protocols are put in place. The ideal monitoring programme should embrace

- a) The impact on badger populations in the cull area - monitoring badger populations is difficult, although assessing levels of sett activity by looking for inactive setts will be easier than trying to determine the reduction in numbers of individuals. Monitoring the prevalence of bTB in culled badgers is unlikely to be realistic given the large numbers that would have to be examined in detail to determine any change, and the associated cost of doing so.
- b) The impact on bTB incidence in the cattle population (comparing changes in implementation areas with carefully selected comparison areas) -based on experience from the RBCT a comparative analysis will be needed to see any effects. However, this could be difficult to implement as the selection of matched control areas will not be random, and their number, size, and location will not be known in advance.
- c) The humaneness of culling procedures.

- d) Close monitor of culling and/or vaccination to ensure that they comply with the terms of the licence.
- e) It is important to note that the final report on the RBCT found a significant effect on confirmed breakdowns but not on unconfirmed breakdowns. It may be informative to examine if there were any effects of proactive culling on unconfirmed breakdowns after the RBCT ended.

Finally we advise that all data that are collected from any operation should be made available for analysis by any interested party, subject to the usual confidentiality constraints.