The badger cull debate

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December 2017.

Chipping Norton is in the area of the UK with the very highest level of cattle TB. As of the end of 2016, 17% of herds in our area of Oxfordshire were 'under restriction" (see below) because of TB.

In 2013, farmers in England were given the option – at their own expense – to cull badgers under (government) license from Natural England. This was initially carried out over a period of six weeks in an area of West Gloucestershire and in an area of West Somerset. Over the intervening years, the number of licensed cull areas has increased to 21 in 2017, and includes areas of Cheshire, Cornwall, Devon, Dorset, Gloucestershire, Herefordshire, Somerset and Wiltshire. These culls consist of shooting the badgers, over a limited part of the year, in which time a number of badgers between a pre-determined minimum and maximum number must be culled.

This Q&A document gives the background to the Government's decision to cull badgers and explores some of the associated issues.

What is cattle TB?
Tuberculosis (TB) is a slowly progressing, chronic, often fatal disease of many mammal species caused by slow-growing bacteria called *Mycobacteria*. Several types of *Mycobacteria* can cause TB in a wide range of mammals and other animals. *Mycobacterium tuberculosis* is the main cause of TB in humans, but it does not often infect other mammals. The main cause of TB in cattle is the closely related *Mycobacterium bovis*, and that bacterium also causes disease in people, badgers, deer, sheep, goats, camelids (alpacas and llamas), cats and many other mammals.

How much cattle TB is there in the UK?
A lot! Before 1950 almost the whole country was heavily infected. In 1950 compulsory control measures (see below) were introduced and by the late 1970s these measures had led to the virtual elimination of TB from the country's cattle – by the 1980s less than one in 10,000 cattle were infected and almost all of those animals were in localised areas of South West England. Since the 1980s, however, TB has been spreading North and East and now the chronically affected area of the country includes South West England, most of Wales, much of the Midlands and Cumbria. In England alone in 2016, 29,241 cattle were slaughtered for TB control, and further infected cattle were identified in abattoirs after having been slaughtered for other reasons. In England in 2016, an average of 5.4% of all cattle herds in England were 'under restrictions' (see below) at any one time because of TB; that is over 2,700 herds. Control of cattle TB is currently costing Great Britain about £100 million pounds a year.

Do badgers spread bovine TB to cattle?
Yes. In many parts of the country where TB is a problem in cattle, a high proportion of badgers are infected with exactly the same strain of

Mycobacterium bovis as are the cattle. Two pieces of evidence very convincingly demonstrate that badgers infect cattle. The first is that all six trials of badger culling that have been carried out in TB-affected areas of the UK and the Republic of Ireland have shown that systematically reducing the badger population in an area reduces the incidence of TB in the cattle within that area. The second is that, in one of those studies (the Randomised Badger Culling Trial), it was also demonstrated that badger culling within an area increased TB in a band around the outside of that area; the explanation appears to be that culling some of the badgers perturbed the social dynamics of the badger communities, resulting in some of the surviving infected badgers moving out of the area, so spreading the infection to cattle (and other badgers) outside the area. Similarly, when culling of badgers within an area was restricted to 'reactively' culling only those badgers around farms with a new outbreak of TB in their cattle, the overall level of TB in cattle in that area increased. Again, this is thought to be due to this 'perturbation effect' resulting in increased movement of surviving infected badgers within the area.

Are badgers the only factor in the spread of TB in cattle?
No. On a local scale, cattle-to-cattle spread is the single biggest factor, but in the TB-affected areas of the country badger-to-cattle spread is the next biggest factor. In areas of the country where there is much TB in cattle, large proportions of the badger population are often also infected. In the most heavily affected areas, studies have estimated that badgers are responsible for up to 50% of all herd 'breakdowns' (new detections of TB in herds that had previously been free of TB). Badgers are also a major problem for TB control in the Republic of Ireland. In some other countries, other wildlife species play a similar role to badgers in the UK as 'reservoirs' of bovine TB infection; e.g., common brushtail possums in New Zealand, and white-tailed deer in Michigan in the USA. In the UK, it is possible that other wild mammal species may also play a role, although much less so than badgers. The movement of people, vehicles and machinery between farms may also play a small part.

On a national scale, by the 1970s eradication efforts had restricted cattle TB to a relatively small area of South West England. However, since the 1980s cattle TB has gradually spread North and East across England, and also across much of Wales. Again, many factors are involved in this spread. On a local level, at the edge of the spreading infected area, cattle-to-cattle, badger-to-badger and badger-to-cattle spread will be playing a role. On a larger scale, movement of infected cattle out of the TB-endemic area has also caused spread – for example, after the foot-and-mouth disease outbreak of 2001 caused many farmers to lose their herds, cattle TB was established in Cumbria as a result of restocking using cattle bought in from infected areas in the UK and Eire. However, evidence suggests that these processes are not the primary driver of the spread North and East across the UK.

So, what is the primary driver of this spread? To answer that, I need to first explain that the *Mycobacterium bovis* bacteria causing bovine TB exist in many (around 90) different strains – 'genotypes' – identified by genetic testing. There are two types of genetic variation tested to identify genotypes, 'spoligotype'

testing and 'variable nucleotide tandem repeat' (VNTR) testing. There are several different spoligotypes of *Mycobacterium bovis*, and multiple VNTR types of each spoligotype. Every new herd breakdown in which *Mycobacterium bovis* is isolated has at least one sample of *Mycobacterium bovis* identified genetically by APHA scientists. Each different spoligotype is given a number, and each VNTR type a letter so that all genotypes have a unique number:letter identifier, e.g., 10:a or 12:b. Analysis of the strains show that almost all genotypes are moderately to highly localised across the UK. The area where a genotype is localised (i.e., found most commonly) is called its 'home range'. In 2016, 84% of all new outbreaks were caused by *Mycobacterium bovis* genotypes in their home range. In general, 95% of cases were in their home range or within 50 km of their home range (and half of the cases outside the home range were explained by movement of cattle from the home range). Chipping Norton Vets, in Northwest Oxfordshire, is in the genotype 10:a home range. Around here, most cattle TB outbreaks are caused by that genotype, but travel just 10-15 kilometers East, or around 30-50 km in any other direction, and other genotypes predominate instead. In East Sussex, cattle TB is almost all the 13:a genotype. Similarly, in any other TB-endemic area, the infections are almost all due to one or two local genotypes. In other words, in each area of the country, TB is being caused by different types of *Mycobacterium bovis*. This means that, to a large extent, the spread of bovine TB across the country is not caused by animal-to-animal spread North and East from the Southwest, as would occur, for example, for influenza. Rather, the TB that is appearing in cattle and badgers on the 'edge' of the spreading front of the TB-infected area **was already there** in the previously 'TB-free' area – presumably in the ground or in some wildlife reservoir – and some unknown factor(s) has caused that previously 'latent' TB to be able to infect cattle and badgers.

So, what is the unknown factor, spreading North and East across the UK, apparently starting in the 1980s, that is causing the pre-existing 'silent' TB in previously 'TB-free' areas to start infecting cattle and badgers? Nobody knows. Many things have changed over that period, including climate warming, agricultural practices (fewer but larger cattle farms, different cattle breeds, much more use of maize for cattle feed, hedges dug up, much more monoculture agriculture, invasive wildlife species, large reductions in many indigenous wildlife species, etc.). One of these changes is the very large increase in the number of badgers.

Why are badgers such a problem and not other wildlife?

Other wild mammal species can be infected by bovine TB, and may perhaps spread infection to cattle. However, surveys of various mammal species in areas of the UK where cattle and badgers are infected have shown that the other mammal species are either uninfected, or have much lower infection rates than do badgers. There are a few, relatively small areas of the UK where deer may also be an important wildlife reservoir of bovine TB.

Badgers appear to be a particular problem for a number of reasons. One is that they spend a lot of time in close contact with each other in their poorly ventilated setts, ideal conditions for spreading TB from badger to badger. They also fight,

and TB can be spread via bite wounds. Badgers are susceptible to infection, and once infected they often remain clinically healthy for years while shedding the bacterium into the environment, and some have been shown to shed very high numbers of *Mycobacteria*. When foraging for food badgers often come into (usually indirect) contact with cattle in their shared environment, thereby possibly infecting the cattle with TB. Cattle pasture is an ideal hunting ground for badgers to find their favourite food of earthworms, and badgers often have 'latrines' on pasture grazed by cows. Badgers also enter farm buildings where cattle are housed and cattle feed is stored.

How is TB controlled in cattle in the UK?

All live cattle are regularly tested for TB by injecting tuberculin into the skin of the neck and assessing any reaction three days later (the 'single intradermal comparative cervical tuberculin,' or SICCT, test). In areas of the UK in which bovine TB is not currently a problem (broadly, Scotland and North and Eastern England), herds are tested every four years. In those areas of the country in which bovine TB is a problem (Northern Ireland, Wales, the Midlands, Southwest England and some of East Sussex), herds are tested annually, and on any farm on which any animal(s) has tested positive, the whole herd is tested roughly every two to three months until two consecutive whole-herd tests done at least 60 days apart are negative. Until there have been two such 'clear' tests the herd is put under 'movement restrictions' meaning that no cattle can be moved on or off farm, except to go for slaughter (so, the restrictions last a minimum of just over four months and often very much longer). In addition, any cattle to be moved from one clear farm to another must have a negative result on the SICCT test before they can be moved. Furthermore, all cattle carcases are checked for TB lesions after slaughter at the abattoir. If any are found to have TB, the herd of origin is put under restrictions and tested as above. Across Great Britain, about 21% of new TB herd breakdowns are identified in cattle sent for slaughter at the abattoir.

The tests are not perfect. The SICCT test does not directly detect the presence of the TB bacterium, but the presence of an immune response to it. Although the SICCT test is reasonably accurate, and rarely indicates the presence of infection in uninfected animals (i.e., 'false positive' results are rare, perhaps 1 in a 1,000 animals tested), it does fail to detect some infected animals, so 'false negative' results are common; around 20% of the infected animals in a tested herd will be missed, especially those early in infection. This high false-negative rate is one reason why positive herds are repeatedly tested – the repeat testing will detect some of the earlier false negatives. Some infected herds are tested with a more sensitive blood test (the gamma-interferon assay), but while that test is less likely to miss infected animals, it does tend to falsely identify some uninfected animals as infected (i.e., there are more false positives), resulting in their slaughter.

Why is cattle TB spreading despite these control measures?

This control strategy of testing herds regularly, slaughtering all infected animals and restricting the movement of all cattle that have been in contact with them (so that those cattle cannot spread infection to other cattle) is logical. However,

it is based on the fundamental assumption that it is only cattle that spread TB to other cattle. If that assumption is incorrect, because other known or unknown factors also spread TB to cattle, these control measures are likely to fail because they are not addressing those other factors.

Prior to 1950, when compulsory testing of cattle herds was introduced, cattle TB was widespread throughout most of the UK and by using these 'test-and-slaughter-and-restrict-movement-of-in-contact-cattle' measures bovine TB had been eradicated from all of the country except a relatively small area of South West England by the 1980s (between 1975 and 1980 badger culling by pumping poison gas into setts was also used). Even now, whenever there is a localised outbreak of TB in cattle well outside the currently chronically-affected areas of the country – almost always due to movement of tested-negative but actually infected cattle from within the chronically affected area – rapid application of these measures effectively stamps out each local outbreak. Many other countries have successfully eradicated or greatly reduced bovine TB using similar regimes to that currently used in the UK. Thus, it is clear that these control methods can and do work to eliminate TB from cattle both abroad and in parts of the UK.

However, despite the continuing use of these control measures, since the late 1980s TB has rapidly spread out from small areas of South Western England into Wales and the Midlands. In addition, similar measures have failed to eradicate cattle TB in some other countries or areas abroad including the Republic of Ireland, New Zealand and Michigan in the USA.

Thus, one or more factors are preventing the UK's control measures from being effective in a large part of the UK even though similar methods have been effective in other countries, were effective in the same areas of the UK just a few decades ago, and are still effective in stamping out new outbreaks in other areas of the UK now. A reservoir of bovine TB in the environment, in wildlife species, could be such a factor. Each of the countries in which standard control measures have failed to eradicate cattle TB – the UK, the Republic of Ireland, New Zealand and Michigan in the USA, has a significant reservoir of bovine TB infection in wildlife. The UK differs from many other countries in having far more badgers, and UK badger numbers are much higher now than when TB was successfully eradicated from large parts of the UK between 1950 and the 1980s. Since the 1980s, TB has been spreading back across the country again. This spread has coincided with the large increase in the badger population that has occurred since badgers were declared a protected species in 1973 (to protect badgers from badger baiting). These observations suggest that the known reservoir of TB in badgers in the chronically affected areas of the country is contributing substantially to the TB problem in cattle. As noted above, the fact that all of the studies in the UK and the Republic of Ireland that have investigated the effect of reducing badger numbers on TB levels in local cattle have shown that reducing badger numbers reduces the incidence of cattle TB also indicates that badgers are strongly implicated in spreading TB to cattle.

In summary, it appears that the 'test-and-slaughter-and-restrict-movement-of-in-contact-cattle' measures can and do work when *only* cattle are infected. When

there is another significant source of infection in the environment, these measures fail to clear the infection. This failure is to be expected, precisely because these control measures rest on the assumption that only cattle are infected. Thus, individual infected herds in the affected area of the country may have their infection cleared by repeated testing and slaughter of reactor animals, but TB persists in the environment (and often in neighbouring farms), and so that herd may become re-infected, test positive again and be put back under restrictions. In both the localised outbreaks outside the chronically affected area of the country, and in infected herds in the chronically affected area, the control measures can clear the infection from cattle. However, if no action is taken to remove the reservoir of infection from wildlife, and the wildlife come in direct or indirect contact with the cattle, the cattle will become infected again.

A wildlife reservoir of TB may not be the only factor contributing to the spread of cattle TB over the last three decades, as other factors have changed since the 1980s. The UK also differs from many other countries in having a relatively large amount of cattle movements between farms, and there may be more cattle movements now than there were before the 1980s. Another relevant factor may be that the average size of cattle herds has increased substantially since the 1980s.

What can be done to reduce TB infection in the environment and its spread to cattle?

Biosecurity – limiting direct or indirect contact between infected and uninfected animals – is important to prevent spread of infection. This includes various measures such as making cattle food stores as wildlife-proof as possible, attempting to keep wildlife out of farm buildings, and attempting to keep TB-infected animals (other cattle or wildlife) or potentially contaminated equipment off unaffected farms. It is impossible to keep badgers off pasture, but there may be ways to limit spread of infection – e.g., badgers tend to use latrine areas that, if identified, could perhaps be fenced off to prevent cattle grazing them.

There are only two options for reducing the reservoir of TB in wildlife – culling or vaccination of the wildlife.

Can culling badgers reduce TB in cattle?

Yes. There have been six trials of the effects of culling badgers on levels of TB in cattle, in each of which culling badgers was associated with a reduction in the level TB in local cattle. Two of these trials were in the Republic of Ireland (the East Offaly Badger Research Project in 1989-1994 and the 'Four Counties' trials in 1997-2001) and four were in the UK (at Steeple Leaze in Dorset 1973-1975, Thornbury in Avon 1975-1978, Hartland Point in Devon 1979-1984, and the Randomised Badger Culling Trial, also known as the Krebs trial, which took place over ten sites across South West England in 1998-2005). The largest and most scientifically rigorous trial, the Randomised Badger Culling Trial (RBCT), produced very high-quality scientific evidence that proactive culling of badgers caused an overall reduction of TB in cattle that persisted for many years after the badger culling ended. In the RBCT the reduction in cattle TB was fairly modest, and that may have been associated with the fact that the cull did not remove a

very large proportion of the badger population. It is difficult to estimate badger numbers accurately (they spend a lot of time underground and are above ground mostly after dark), but it is estimated that the RBCT cull reduced the population by only about 30-70%. However, this high-quality evidence that badger culling reduces the level of TB in cattle is supported by the results of the five other studies, in each of which a greater proportion of the badger population appears to have been culled, and that resulted in greater reductions in TB in local cattle.

In addition, a recent study assessed cattle TB levels in the first two farmer-led culling zones (West Gloucestershire and Somerset) after the first two years of culling. Although not a randomised trial, the study did find evidence of a reduction of cattle TB in both culling zones.

The RBCT also produced perhaps the strongest evidence showing how effectively badgers can transmit TB to cattle. In areas in which badgers were culled reactively (i.e., in response to a new TB breakdown in local cattle) and only in localised parts of the culling trial area, rather than proactively over the whole culling trial area, TB levels in cattle actually increased. In addition, for areas of proactive badger culling, whereas cattle TB levels fell in the cull area, cattle TB increased (by a smaller amount and for a shorter time than the decrease) in the area immediately surrounding the cull area. These increases of cattle TB have been called the 'perturbation effect' and are thought to arise because culling changes the social dynamics of the badger groups, resulting in badgers that survived the cull – including TB-infected badgers – roaming more widely, and thereby infecting both more badgers and more cattle.

Thus, the evidence has shown that badger culling can decrease TB levels in cattle, but that for badger culling to effectively reduce TB in cattle, the cull must be done according to specific criteria. To cull using other criteria can reduce effectiveness or even result in an increase of TB in cattle; for instance, reactively culling only those badgers local to a cattle TB outbreak in response to that outbreak can make the situation in cattle worse. The most effective way is to cull proactively, killing the majority (certainly more than 70%) of the badgers in a large area that has relatively non-porous-to-badgers boundaries, such as coast, rivers or motorways. This is what the 2013 and 2014 pilot culls in Gloucestershire and Somerset were designed to do. The cull will need to be sustained over some years. Past studies have shown that after just a few years of badger culling, it takes several years for the full effect of disease reduction in the local cattle to become apparent, consistent with TB being such a slowly progressing disease.

Nobody believes that culling badgers alone will eliminate cattle TB, but the evidence shows that badger culling as part of the larger package of control measures will reduce TB in cattle more than will using those other measures without badger culling. Further, in those areas in which bovine TB is endemic in badgers, it is vanishingly unlikely that TB in cattle could be eradicated without addressing this wildlife reservoir of infection.

Are the on-going badger culls reducing TB in cattle?

Although it is early days to tell for sure, there is some evidence that the farmer-led culling is reducing cattle TB. As mentioned above, a study assessed cattle TB in the first two culling zones (West Gloucestershire and Somerset) after the first two years of culling by comparing them to 10 other comparable areas where there was no culling. The analysis suggested decreases in the amount of cattle TB. Time will tell if that finding is repeatable and consistent.

Will culling badgers improve cattle welfare?
No. A TB infection left to develop in a cow would undoubtedly be a serious welfare issue for that cow. However, TB develops very slowly, typically over years. All cattle in the UK are routinely tested for TB and those tests are done at least yearly in infected areas and much more frequently in herds known to be infected. Thus, infected cattle are detected, and as a result slaughtered, usually long before they develop significant illness. Culling badgers should decrease TB-infection rates in cattle, but because infected cattle are almost always slaughtered before they become ill, while badger culling will extend the life of some bovines it will not significantly improve their welfare.

Will culling badgers contribute to the protection of public health?
Not significantly. Bovine TB is a public health concern – before control measures were implemented, bovine TB killed many people every year in the UK (in the 1930s there were more than 50,000 cases of bovine TB infection in humans annually, causing 2,500 human deaths each year) – and it still does so in less developed countries. There are still some – less than 40 – human cases of bovine TB in the UK each year, mostly in the elderly and thought to be reactivation of 'latent' infections actually contracted decades ago, or in immigrants and thought to be contracted abroad. Historically, almost all infections in humans in the UK arose from drinking contaminated milk. Pasteurisation (heat-treatment) of milk was introduced to prevent infection of milk consumers. In addition, milk tends to become contaminated relatively late in infection and, as noted above, nowadays most infected cows are detected and slaughtered early in infection. Thus, the risk to the public from purchased milk is miniscule (there is a larger risk for the small minority who choose to consume unpasteurised milk). Cattle slaughtered for human consumption are also checked at the abattoir and any lesions suspicious for TB removed.

People in close contact with infected cattle or other mammals can become infected with bovine TB but this is rare in the UK – perhaps two or three cases per year are contracted from cattle or other livestock; with farm workers, vets and abattoir workers at most risk. The incidence of infection in people in contact with infected cattle may be so low largely because the infected cattle are in the relatively early stages of the disease (as a result of TB testing and slaughter of test 'reactors'), and so are not very infectious – if TB controls stopped so that there were more cattle with advanced TB, it is very likely that there would also be more infections among people in close contact with cattle. As long as TB testing continues, the risk of people contracting TB from cattle will remain low whether or not badgers are culled. If culling badgers does reduce the overall prevalence of bovine TB, then that will, presumably, slightly reduce the already very low risk to people.

Then why cull badgers?
Primarily for economic reasons. Bovine TB control (excluding badger culling) currently costs the UK government around £100 million per year and, as TB continues to spread, that cost increases annually. It is also costly – both financially and emotionally – for affected farms, and that has a knock-on effect for rural communities. The government compensates farmers for those cattle that are slaughtered because of a positive result in a TB test, but there are very substantial additional costs to farmers that the government does not compensate for. TB has driven farmers out of business. Reducing cattle TB will reduce the costs to the taxpayer and to the farming industry, and the evidence indicates that culling badgers should help to reduce cattle TB.

Will culling badgers reduce the cost of cattle TB?
The evidence indicates that badger culling will reduce TB in cattle and so will reduce the direct costs of TB in cattle (compensation for slaughtered animals, costs of testing, etc.), and that is why the English and Welsh governments support culling. However, in the short to medium term the costs of culling (to farmers, who will pay for the culling, and to taxpayers, who will pay for the policing) might turn out to be as great or greater than the savings resulting from the cull. The only way to find out is to actually do a cull and that is the point of the pilot culls – to find out if culling over large areas is practical and sufficiently humane, and to determine if it reduces the overall cost of TB. The costs of the cull to the taxpayer may be substantially increased by the activities of people protesting against the culls and of animal-rights activists. Those activities may also reduce the number of badgers killed, which could decrease the effectiveness of the cull in reducing bovine TB, so reducing the expected savings.

There is a vaccine against TB, so why not vaccinate cows?
Three reasons. First, the best vaccine we currently have for cattle (called BCG, the same vaccine used in humans) is not very efficacious – it appears to be only about 65% effective in cattle. Second, it is not currently possible to reliably distinguish a vaccinated cow from an infected cow, so vaccination would seriously undermine the current TB control measures. Third, it is illegal in the EU to vaccinate cattle for TB and the resulting trade restrictions by foreign nations would greatly damage the UK cattle industry and economy (costing the UK far more than the current TB control measures – an estimated £2.2 billion). The Government has outlined plans to vaccinate cattle and has formally discussed these plans with the EU, but it will be well over 10 years before these problems can be solved – if indeed all of them can be solved – and the UK will be able to effectively and legally vaccinate cattle.

Then why not vaccinate badgers instead of culling them?
There is not yet a suitable vaccine that has been shown to be sufficiently effective. BCG, the current injectable vaccine, when given to uninfected badgers appears to be poorly effective at preventing infection, but does reduce the progression and severity of the disease and shedding of the TB bacterium. Vaccinating an already infected badger has little or no effect on that badger – the disease progresses as it would have done without vaccination. A small amount

of evidence indicates that vaccination of adult badgers reduces spread of the disease to cubs. Thus, vaccination appears to reduce the 'disease burden' in a population of badgers and may well do so very significantly if continued over some years (there is some evidence suggesting that 'booster' vaccinations may be required after a year or more to maintain vaccine efficacy), giving time for already infected badgers to die off. The reduced disease load, and the associated reduction of shedding of *Mycobacteria* into the environment, can be anticipated to reduce infection of cattle by the badgers. However, studies have not yet been done to determine whether or not vaccinating badgers reduces TB in the local cattle.

Unfortunately, there is not yet any oral vaccine for badgers and vaccinating badgers by injection is expensive – it costs more than culling them and may need to be repeated. In a preliminary trial of badger vaccination in Wales, the cost of each vaccination was estimated at £662 per badger. The Welsh Government is running a five-year 'Badger Vaccination Project' that began in May 2012 in its TB 'Intensive Action Area', and in summer 2014 Northern Ireland started a five-year 'test, vaccinate, remove' (remove means kill) research project in a 100 km^2 area of County Down. In England many groups are vaccinating badgers with BCG, and the government is actively supporting the vaccination of badgers in the 'edge area' – those counties through which cattle TB is spreading northwards and eastwards from the Southwest.

Work is continuing to develop more efficacious and easier to deliver vaccines for badgers, but that will take many years. In the meantime, there is very strong evidence that culling badgers can reduce TB in cattle, but there is not yet any evidence that vaccinating badgers reduces TB in cattle. It may eventually turn out that vaccinating badgers does reduce TB in cattle, but – given that TB in cattle needs to be reduced now – if action is to be taken to address the contribution of badgers to cattle TB, then it is more evidence-based, rational and economically efficient, if less popular, to cull rather than vaccinate badgers.

Over the longer term, it may be that culling followed by vaccination of the remaining badgers is the optimal strategy.

What do UK vets think about badger culling?

There has been substantial veterinary input into the national badger-culling debate, but there has been debate within the veterinary profession too. Although nobody likes the idea of killing badgers, veterinary surgeons are aware that population disease control sometimes requires tough decisions. A large proportion of veterinary surgeons in the UK work only with pets and have little or nothing to do with farm animals, and so most of those vets contribute little to the debate. The British Small Animal Veterinary Association, the main veterinary organisation representing 'pet vets,' takes the view that the issue of cattle TB and badger culling is outside both its expertise and its remit. The majority of farm vets, especially in the affected areas of the UK, and the main veterinary organisation representing farm vets, the British Cattle Veterinary Association (BCVA), are very strongly in support of badger culling to control TB. The organisation that acts to represent the UK veterinary profession as a whole, the

British Veterinary Association (BVA), also views badger culling as necessary to control cattle TB, and so supports badger culling, but has concerns about the humaneness of the method used to cull badgers. Both the BCVA and BVA have lobbied the government in support of badger culling. Nevertheless, some vets strongly oppose the badger cull. The veterinary organisation that represents vets involved with wildlife, the British Veterinary Zoological Society, while recognising that badgers are part of the bovine TB problem, formally opposes the badger cull.

Is killing badgers unethical?

In general, the consensus of our society is that sentient animals should not be killed without good reason. What constitutes a 'good' reason varies from case to case and may be hotly debated by different groups. For example, there is a strong consensus in most countries, including the UK, that killing rats and mice for pest control is not just acceptable but desirable, but a less strong consensus that killing them for medical research purposes is acceptable. Other wild mammal species are routinely culled in the UK for a variety of reasons, e.g., the government encourages culling of wild deer to protect the environment from overpopulation. In the UK, deer and some other mammal species are 'game' and are shot for sport, and there is a large UK industry raising game birds for sport shooting – estimated at 35-40 million pheasant and partridge raised and released in 2016. (In some other EU countries, badgers are regarded as game animals). Landowners frequently shoot deer, foxes and rabbits, and have an absolute right to do so, provided it is done humanely. Badgers are a special case in that they are protected in UK law, so it is illegal to kill them without a special license. Badgers were not protected because they were an endangered species, rather the legislation was created to abolish badger baiting and it was enacted in 1973, before the role of badgers in bovine TB was fully realised (the first case of bovine TB in a badger in the UK was identified in 1971), and that protection – later strengthened by the Protection of Badgers Act 1992 – has contributed to a substantial growth in the UK badger population.

It is certainly a shame to have to kill badgers, and farmers do not like doing so even when they believe it to be necessary to protect their cattle. However, in terms of ethics and the effect on the animals involved, there is no reason to think that killing badgers is significantly worse than killing other sentient mammals that live in social groups, such as deer, rabbits, rats and mice, and cows. The pilot badger culls involve shooting a few thousand badgers over four years, yet people kill millions of rats and mice every year, by arguably less humane means such as poisoning and spring traps, with scarcely a murmur from animal-rights groups or the public as a whole. Wild badgers live about 2-3 times longer than rats and mice, but even so the pilot culls will result in the loss of far fewer 'badger years lived' than the 'rodent years lived' currently lost as a result of pest-control measures. It is hard to avoid the conclusion that the reason for this difference in attitude is due to emotional rather than rational factors – people in the UK just like badgers more than they like wild rats and mice.

Although badgers are protected in UK law, they are not protected in European law. Some EU countries have legislation protecting badgers, some EU countries

cull badgers as part of their TB control measures, and in some EU countries badgers are regarded as game and are legally hunted. In addition, badgers were culled in several EU countries for rabies control purposes – with a very strong consensus that that was the right thing to do.

In 2012 alone about 38,000 cattle were culled in Great Britain as a result of bovine TB control measures. In the two pilot badger culls in 2013 a total of around 1,879 badgers were culled.

Is the method of culling – by shooting free-ranging animals – inhumane?
A major argument of the anti-cull lobby has been that shooting free-ranging badgers is inhumane. Indeed, it is largely that argument that has led to the current pilot culls, rather than more widespread culling. The pilot culls are being undertaken not to determine whether culling badgers reduces TB in cattle – that has already been conclusively demonstrated by previous trials in the UK and by evidence from other countries – but to determine whether badgers can be culled in sufficient numbers and humanely using this methodology.

Culling wild animals is never completely welfare friendly. Deer, foxes and rabbits are shot in huge numbers compared to the numbers of badgers to be culled in the pilot culls, using the same method, i.e., the shooting of free-ranging animals. In fact, the methods used to shoot badgers in the pilot culls are much more tightly specified and controlled than the shooting of those other species, and the behaviour of badgers generally makes them easier for marksmen to make a clean kill than is the case for the other species. It is hard to see why, if society considers it acceptable to kill deer, foxes, rabbits, hares and game birds by shooting free-ranging animals, it should be unacceptable to use the same method to cull badgers.

DEFRA are investigating other methods of culling badgers. In the 1970s and early 80s badgers in South West England were gassed in their setts using hydrogen cyanide gas, but this method was deemed inhumane and so stopped in 1982, to be replaced for a while by trapping followed by humane killing (usually shooting). DEFRA are now again investigating the practicality of gassing badgers (so far without using any live badgers), perhaps using carbon monoxide.

Is there anything in this for the badgers?
Obviously, all this is nothing but bad news for the current badger population (with the exception, perhaps, of any individual badgers shot while ill with TB, as they will die a quicker, less unpleasant death). Over the longer term, however, it can be argued that there may be a benefit for badgers. There are very high rates of bovine TB infection in badgers in some areas, which is a welfare problem for the infected badgers. Many infected badgers eventually develop chronic illness and, partly because of the behaviour of other badgers towards ill badgers, die an often protracted, unpleasant death. Thus, if TB could be reduced or ideally eradicated from those areas (which is the eventual aim) that would, in the long-term, be in the best interest of the badger population in those areas. There is some evidence from Southern Ireland that the years of badger culling in that country has improved the health of their badger population.

Is culling badgers the right thing to do?

Many countries around the world cull wild mammals, including deer, wild boar, water buffalo, possums and badgers, specifically to aid control of cattle TB. The Republic of Ireland has been culling badgers to reduce cattle TB for over 25 years. France also culls badgers to control TB. For each country, if reliable evidence indicates that culling can help to control TB in that country, then whether to cull or not to cull is a political question with no absolute right or wrong answer - it depends on a balance of widely differing factors and viewpoints, and different countries may reach different answers to the same question. In the UK at present, if the priority is to reduce TB in cattle then culling badgers is definitely the right thing to do. If the priority is to reduce the economic impact of TB in cattle then, although the case is not so clear, it is probably the right thing to do, and the pilot culls will hopefully help to prove the case one way or the other. If the priority is not to kill wildlife then culling badgers is the wrong thing to do. The government has had to weigh the arguments and make the decision.