Badgers and Bovine Tuberculosis 2009

Summary

The badger is not an endangered species in Britain -- on the contrary, it is a very successful one. It has, however, been seriously persecuted in both the distant and more recent past and so is legally protected.
There is no doubt that badgers are affected by Bovine Tuberculosis, and are infected by the same strains of Mycobacterium bovis (the causative agent) as are found in the local cattle.
There is also no doubt that the incidence of bovine TB in cattle has increased numerically and spread geographically since the 1980s, and that it continues to do so.
There is compelling evidence of a wildlife reservoir of bovine TB infection. However, the quantitative significance of badgers and other wildlife species as agents of infection is not clear, nor is the method of transmission of the disease between wildlife and cattle.
There is evidence that transmission between cattle has a role in the geographic spread of the disease.
The precise results of the Randomised Badger Culling Trial (RBCT) remain controversial. However, it is clear that reactive culling may be counter-productive; and proactive culling over large areas is unlikely to yield a net benefit to cattle farmers and Society.
Research is being undertaken into the potential for vaccinating cattle and badgers, and into improving methods of diagnosing bovine tuberculosis in cattle.

The Badger in Britain

The badger Meles meles is Great Britain's largest land carnivore and one of the most abundant. A survey during the 1990s found that the population had increased over the previous decade. The estimated population of adult badgers at that time was between 250,000 and 300,000 animals.
This population is unevenly spread across the country: about 25% of badgers occur in southwest England, but only 10% in Scotland. Generally, hilly country with a mixture of habitat types is most suitable for badgers because it provides food resources and cover at suitable sites for their setts.
It has been suggested that the increase in the badger population between the 1980s and 1990s was partly a consequence of the better survival of adults, owing to the effectiveness of a series of badger protection acts passed by Parliament during the period 1973 to 1992. However, the number of badgers also increased in an area where there was no persecution over a long period of time, suggesting the involvement of other factors such as changing weather patterns.
There is no evidence to support recent claims that the badger population has increased exponentially or is ? out of control?. On the contrary, since 1999 badger numbers have declined in the two areas where long-term studies have been carried out, namely, Wytham Woods in Oxfordshire and Woodchester Park in Gloucestershire.

Bovine Tuberculosis in Britain

Bovine Tuberculosis is a disease caused by the bacterium Mycobacterium bovis. It is primarily a disease of cattle and other ungulates (such as goats and deer), but can infect a wide range of wildlife hosts and can cause disease in humans.
MAFF made strenuous efforts during the 1950s and 1960s to eliminate the disease from cattle by regular testing of cattle and slaughtering of those that reacted positively to the test. This was largely successful insofar as the number of herds containing positive reactors dropped from 40% pa in 1932 to 0.2% pa in 1960.
However, success was not uniform and in southwest England, the incidence of positive reactors in the regular testing programme remained higher than in the rest of Britain. Since the 1980s, the numerical incidence of TB in cattle has increased exponentially and the disease has spread geographically outwards from its original foci in southwest England. Wider geographical spread has occurred in the last few years, which has been linked to an increase in cattle movements following the outbreak of foot and mouth disease in 2001. However, the southwest of England and south Wales continue to contain many hot-spots of infection.
Despite having spread geographically, TB in cattle has remained largely concentrated, since the 1980s, in particular geographical regions. Identifiable genetic strains of TB (spoligotypes) are also to a large extent geographically localised.
Bovine Tuberculosis in badgers

From 1980 to 1990, MAFF examined road-killed badgers and badgers culled from control campaigns. Examination of road kills showed that badger populations throughout southwest Britain carried TB, but that relatively few individuals were infected. Fewer badgers were examined from elsewhere but among these the level of infection was even lower. The culled sample, from areas in which cattle had already demonstrated the presence of TB in the ecosystem, showed a higher infection rate. Sampling of badgers has continued since 1990 and shows an increase in the incidence of TB.
Research into badger ecology and TB epidemiology in Gloucestershire since the 1970s has shown that:

o Badger density has increased overall during the course of the study, though it has declined to some extent recently;
o TB prevalence varies over time, possibly in a cyclic manner;
o TB does not spread rapidly through the badger population;
o TB is not a major cause of death in badgers;
o Badgers sometimes survive for many years while infected;
o Transmission of the disease from mother to cub is potentially important;
o Infection via the respiratory tract and bite wounding are probably the main routes of transmission between adult badgers;
o The relationship between badger density and disease prevalence is not linear, i.e. it does not follow that high badger density corresponds to high levels of TB.

Efforts to find a strategy for controlling the disease

Up to the time when the disease was first found in badgers, cattle were regularly tested and then slaughtered if found to be infected. Similarly, approaches to reducing the risk of infection passing from badgers to cattle have involved killing badgers.
A variety of badger culling strategies has been employed since the 1970s in combination with cattle test and slaughter. While these were associated with reduced incidence of TB in cattle in some circumstances, they have clearly not succeeded in eliminating, or even containing, the problem as a whole. A recent cull in Ireland has claimed a significant reduction in the incidence of TB in cattle. However, direct extrapolation to the British situation is not possible due to different farming practices and methods of badger culling.

The Randomised Badger Culling Trial

Following publication of the report on badgers and TB by John Krebs and his colleagues, the Randomised Badger Culling Trial (RBCT) was initiated in order to compare the effects of different culling strategies.
The trial tested three treatments, each of which was to have been carried out in 10 areas of approximately 100km2 each:
Proactive culling, which aimed to reduce badger populations to very low levels over the whole of a trial area;
Reactive culling, where only badgers close to TB outbreaks in cattle were removed;
No culling, where badger population density was estimated by surveying but no badgers were removed.
The trial was started in 1997 and results were reviewed in 2003. This review found an increase in the incidence of TB in cattle in reactive-culling areas by comparison with no-culling areas. Consequently, the reactive culling part of the trial was halted.
* The final report of the Independent Scientific Group on Bovine TB, who oversaw the RBCT, was published in 2007. Within this, the ISG reported a decrease in TB incidence among cattle in proactively culled areas, but an increase in TB among cattle in peripheral areas, resulting in little to no net benefit.
Furthermore, from a partial cost ?benefit analysis, the ISG concluded that badger culling does not offer a cost ?effective solution to TB in cattle since any net financial benefits were predicted to be extremely small in comparison to the costs of culling.
The trial has been criticised on various grounds, but especially because of difficulties in enforcing the protocol. Participation was not compulsory, so some landowners in proactive-culling and reactive-culling areas refused to allow badger culls to take place on their land. Conversely, it was difficult, if not impossible, to prevent clandestine (and illegal) culling in no-culling areas. Nevertheless, this is the only rigorous attempt that has been made to evaluate the impact of badger culling on the incidence of the disease in cattle in the UK.
Vaccination
Although there is obvious potential for attempting to control the disease by vaccinating badgers, cattle, or both, the apparent simplicity of this approach belies some inherent difficulties.
Vaccinating cattle would be relatively simple in principle. However, once a cow has been immunised, the skin test that is used to detect TB must be able to discriminate between an infected cow and an immunised

one. No combination of vaccine and skin test is yet available that meets this criterion.

* Catching badgers for direct vaccination would be extremely time-consuming and may not be practical on a very large scale. It is almost certainly going to be necessary to develop a vaccine which can be administered orally in bait, and to devise a baiting protocol which would ensure that sufficient badgers would be immunised for the method to be effective. However, there are a number of inherent problems associated with the development and deployment of an oral vaccine bait.

Research is currently underway in the UK and Ireland to determine the efficacy of BCG as a vaccine for badgers and to develop an effective oral delivery system. The most effective vaccination strategy is likely to be a combination of widespread pro-active vaccination of badgers followed by local intensive programmes in areas where cattle reactors occur.

Cattle testing

The extent to which the incidence of TB in cattle results from cattle-to-cattle transmission is unclear. However, during the last few years there has been a significant increase in the geographical spread of TB in cattle after a period of restocking that was necessitated by a Food and Mouth Disease epidemic in 2001. This suggests that cattle-to-cattle transmission could be a significant factor. A recent statistical analysis of post-2001 cattle movement data confirms this by identifying cattle imports from infected areas as a significant contributor to the geographical spread of TB in cattle during the last few years.

The current test for cattle (the single intradermal comparative cervical tuberculin test) suffers fairly low sensitivity. That is, in Britain it is only likely to detect 80% of infected cattle. On the other hand, it may indicate 1 in 1000 cattle as infected, when they are not.

Defra is currently seeking to improve the cattle testing procedure in an effort to ensure that TB is effectively controlled within the cattle population.

Other potential wildlife reservoirs

The possibility of other wildlife being a reservoir for bovine TB has long been recognised and many species have been sampled, although the number of individuals is low for some of these. Bovine TB has been found in a number of species but the levels of infection are mostly lower than in badgers. Also, some species, although able to become infected, do not become infectious.

A recent report published by Defra suggested that while deer may become infected with TB, it is unlikely that they significantly contribute to the problem in cattle, and badgers probably pose a much greater exposure risk.

Husbandry

A study published in 2008 reported widespread and frequent visits of badgers to farm buildings among a sample of cattle farms in southwest England. Observations on contamination by badgers of stored farm feeds and other resources available to cattle suggested that these visits posed a serious transmission risk to cattle.

Defra is currently carrying out an experiment to assess the benefits of changes to husbandry practices in terms of reducing contact between badgers and cattle within farm buildings.

Changes in farm husbandry may reduce the risks of infection, for example by ensuring that badgers are excluded from structures or places where cattle are fed concentrates, silage or hay.

Alternative approaches

An issue that is rarely considered is the cost of either a ?do nothing? approach, which might lead to the collapse of cattle farming in southwest Britain, or a deliberate policy of running that industry down. The potential impact on a wide range of wildlife species is great, as is the likelihood of unforeseen consequences.

One consequence might be a reduction in the badger population, since livestock farming leads to high densities of earthworms in pasture, which in turn support high densities of badgers. A reduction in the number of badgers could lead to increases in numbers of some of their prey such as hedgehogs and rabbits, or in competitors such as foxes. Some of these changes might be seen as beneficial, others would not.

Another potential consequence is the impact on highly protected and vulnerable species such as bats. The greater horseshoe bat in particular is confined to southwest Britain and is highly dependent on the presence of grazing cattle and their dung, since dung beetles are a major prey item when female bats are raising their young.

Conclusions

The increasing incidence of TB in cattle and badgers is clearly a very complex problem and at present, despite more than twenty-five years of research, there is no obvious simple solution to it.

It is clear that the badger is involved in the epidemiology of TB in cattle, but also that badger culling cannot meaningfully contribute to solving the problem in the UK.

There is a clear need to continue investigations into various aspects of the epidemiology of the disease, into methods of control and, particularly, into the efficacy and feasibility of vaccination.

There is also a need to ensure that the costs and benefits of any proposed control measures are fully evaluated, not only in financial terms but also in terms of the impact on badgers and other wildlife, and on the farming industry.

It is noteworthy that Defra is currently focussing on improvements to the diagnosis of TB in cattle and vaccination of cattle and badgers. Clearly, persistence and spread of the disease in the cattle population is still a problem, but the problem of a wildlife reservoir must also be addressed.