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Badgers face the death penalty for contributing to high rates of bovine tuberculosis.

ANIMAL HEALTH

Badger battle erupts in England

Cull plan splits farmers, conservationists — and scientists.

BY GEOFF BRUMFIEL

England's West Country is a bucolic landscape of winding country lanes and gently rolling pastures. But as autumn darkens into winter, a war, complete with armed marksmen and camouflaged saboteurs, is about to erupt from the hedgerows. Both sides claim science as their ally.

At issue is the badger (*Meles meles*), one of the largest predators left in the British Isles after millennia of human occupation. The furry creature is an iconic and beloved species — but to farmers, it is a menace that infects their cattle with bovine tuberculosis (TB). The disease, caused by the bacterium *Mycobacterium bovis*, could cost the government £1 billion (US\$1.6 billion) in control measures and

compensation over the next decade. As early as this week, government-sanctioned hunters will begin a pilot effort to cull the badgers. Animal-rights activists — a potent force in Britain — are furious, and are planning protests, milk boycotts and sabotage of the culls.

Battles over wildlife management are hardly unique to England. In the United States, environmentalists and ranchers spar over wolves, which have been reintroduced to many states. In Western Australia, the government has proposed a cull of coastal sharks in response to a swimmer's death, angering green groups. But the badger question stands out in one distinctive way: it has been systematically studied for more than a decade by scientists at some of England's top universities.

Badgers do carry TB and can infect cows

through direct and indirect contact, and years of research and tens of millions of pounds have gone into studying whether killing them would protect herds. During a 9-year trial¹, scientists tramped through hundreds of square kilometres of pastureland, probing dens, collecting road kill and performing autopsies on more than a thousand badgers to check for TB. The results are discussed at length in a 287-page UK government study and in numerous scientific papers, including several in *Nature*^{2,3}.

So is the government's decision to let farmers shoot badgers scientifically sound? No, says John Krebs, a zoologist, member of the House of Lords, and principal of Jesus College at the University of Oxford, who recommended running the 9-year study. "They went against the science on political grounds."

Yes, counters David King, a chemist and director of the Smith School of Enterprise and the Environment, also at Oxford. "The government's got it right," he says. When King was the former Labour government's chief scientific adviser in the 1990s he supported culling, and commissioned a separate study that ended up endorsing it⁴. The schism reveals an uneasy truth about the badger issue: science doesn't give a clear answer about what to do.

Here are the facts. For more than a decade, bovine TB has been on the rise in Britain (see 'Bovine burden'). To control the disease, which can spread to humans through contaminated milk, cattle are routinely screened and infected animals are destroyed. And, uncomfortable as it is for animal-lovers, killing large numbers of badgers does help to reduce levels of bovine TB.

The trial backed by Krebs (officially known as the Randomised Badger Culling Trial, or RBCT) showed a 23% reduction in bovine TB in the area of the cull, although the areas immediately outside the trial area saw an increase of roughly 25% — a consequence of badgers extending their normal range. Reviewing the data, scientists decided in 2011 that culling about 70% of the badgers in larger areas would lead to an overall reduction in bovine TB of up to 16%.

There is little disagreement among scientists about the 16% figure, says Christl Donnelly, a statistician at Imperial College London, who has devoted years to analysing the RBCT data. But there is plenty of debate about whether that's enough to justify a kill. Sixteen per cent "doesn't sound terribly meaningful to me", says Jack Reedy, spokesman for the Badger ►

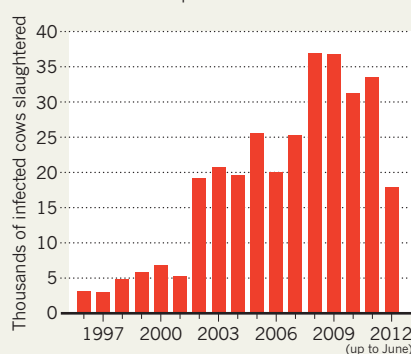
► Trust, a non-profit organization based in East Grinstead, UK, that opposes the killing of badgers. He adds that controlling cattle movements and increasing TB screening on farms would have a greater impact. Adam Quinney, a beef farmer and vice-president of the National Farmers Union in Stoneleigh, which is lobbying for the cull, disagrees. "If I said to you, 'I'm going to give you an increase in income of 16%', would you say that was significant?"

In July 2011, the Department for Environment, Food and Rural Affairs (DEFRA) laid out a plan for bovine TB eradication in England. The plan included increased surveillance and security measures on farms, as well as what the government described as a "science-led policy" of killing badgers in areas of high bovine TB. The plan reflects the reality that "this little micro-organism is really getting the better of us," says Ian Boyd, DEFRA's chief scientific adviser, who supports the cull. Politicians do not expect that the cull alone will eradicate bovine TB, but they hope that it will at least help to stabilize infection rates. Boyd insists that the new policy is rooted in the science of the RBCT.

Test culls will begin in Somerset and Gloucestershire, two of the most heavily infected regions in the country. The cull areas will be larger than those in the original trial, and will use physical boundaries, such as rivers and roads, to prevent infected badgers from roaming in or out of the cull zone. For many scientists, however, the new cull seems too distant from the RBCT to deserve the title

BOVINE BURDEN

English farmers have struggled to control bovine tuberculosis over the past decade.



of 'science-led' policy. The 70% reduction is a particular sticking point, as it is virtually impossible to determine badger populations in advance of actually killing them. On 14 October, 31 academics warned in a letter to *The Observer* newspaper that if the targets are missed, then levels of bovine TB could actually increase, because infected badgers will begin to roam more widely. "They say that their policy will be science-based but that's simply not true," says Krebs, who signed the letter. "They feel they have to do something, and the easiest something to do is to shoot badgers."

Other parts of the British Isles have already taken action. The Irish have used targeted snare-trapping to all but eliminate badgers

from selected areas. That system would be more affordable but it is considered unethical in England. In Wales, officials have begun an expensive campaign to immunize badgers against TB. Both techniques depend on the peculiarities of local geography and badger populations, but they reflect the range of approaches that can be supported by the scientific evidence.

Policy-makers, meanwhile, are frustrated. "Politicians feel that the scientists have let them down," says Phil Willis, a Liberal Democrat and member of the House of Lords Science and Technology Committee. "They've not come with clarity, not just in terms of the science but in terms of the solution." Willis says that based on his understanding of the data, the government policy is unlikely to work.

As both farmers and protesters gird themselves, Donnelly acknowledges that science has given few straight answers. But, she says, it has helped to shift the debate: farmers now admit that tougher biosecurity standards will be instrumental in controlling bovine TB, and conservationists concede that badgers are a major reservoir for the disease. "They may not be singing from the same hymn sheet," she says, "but at least they're looking at the same data table." ■ SEE EDITORIAL P.310

1. Independent Scientific Group on Cattle TB *Bovine TB: the Scientific Evidence* (ISG, 2007); available at go.nature.com/7gdmhd
2. Donnelly, C. A. et al. *Nature* **426**, 834–837 (2003).
3. Donnelly, C. A. et al. *Nature* **439**, 843–846 (2006).
4. King, D. *Bovine Tuberculosis in Cattle and Badgers* (DEFRA, 2007); available at go.nature.com/lmkgec

FOOD SCIENCE

Politics holds back animal engineers

Funds and approvals lag for transgenic livestock in US.

BY AMY MAXMEN

When she saw the trailer for the documentary *Genetic Roulette*, Alison Van Eenennaam wanted to laugh, then cry. The film touts the risks of genetically engineered (GE) organisms, calling them "the most dangerous thing facing human beings in our generation". For Van Eenennaam, a geneticist at the University of California, Davis, the scientifically unfounded assertions — that transgenic foods are responsible for increased incidence of autism, Alzheimer's disease and type 2 diabetes in the United States — cannot be taken seriously. But the film reflects attitudes that have thwarted Van Eenennaam's

research into the genetic modification of animals to reduce food costs and improve quality.

"Twenty years ago, the technology was our hurdle," says Mark Westhusin, who works on GE animals at Texas A&M University in College Station. "Now the technology is great and the sky is the limit," he says, "but good luck getting money for GE animals."

Inquiries by *Nature* reveal that fewer than 0.1% of research grants from the US Department of Agriculture (USDA) have gone to work on GE food animals since 1999, in part because of a poor public image. In one case, James Murray, another geneticist at the University of California, Davis, was told in 2003 that the USDA had rejected his proposal to

develop a goat that produces milk rich in human lysozymes — enzymes that fight diarrhoeal disease — because the agency felt that "the general public would not accept such animals".

Van Eenennaam once hoped to engineer a cow that produced milk rich in omega-3 fats, but the USDA rejected her proposals, and she ended the project because of a lack of funding. The agency now funds her work on conventional breeding techniques to create dairy cows without horns, sparing farmers the danger and expense of removing them. Van Eenennaam says that she might do better by disrupting the genes that lead to horns, but there is no money for that. "I've got plenty of funding now, but the project is completely inefficient compared to genetic engineering," she says.

The USDA supports research to improve livestock and agriculture, but a spokesperson says that it has not considered work on GE animals to be the best use of its funding. The US National Institutes of Health (NIH)

occasionally supports research on transgenic pigs that model human diseases, but rarely funds proposals to produce drugs or vaccines

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For more on the controversy over transgenic foods:
go.nature.com/rypyo5