



Conyers Sixth Form Transition Work

A LEVEL BIOLOGY

Congratulations on your enrolment to Conyers Sixth Form; please find below, tasks that will aid your transition from GCSE to Level 3 study. Your subject teacher will check completion of this work in September.

1. Read the article about TB
2. Research how mRNA vaccines work (like the Pfizer BioNTech COVID vaccine) and make a fact sheet: this can be in work or powerpoint. This should include diagrams.
3. Answer the questions accompanying the TB article

If possible...buy and read this little book (its cheap!)

https://www.amazon.co.uk/Head-Start-level-Biology-Level/dp/1782942793/ref=sr_1_1?crid=2DB2RECLX29KQ&dib=eyJ2IjojMSJ9.KZkL5rgYepCJ1iUUu-d-MPcvAQIT76-wf0hgs1VA4ozhxo7mmRyXXDtdlHTYUQnBplvIASZ_BOZIDR2R3RjTCLKP0EfwwbmynkNMHlwT2H9PsENZot-lx7J5eKBMU8ss.BFn3-o0NstqmQIkRF4x9bbo06uQUrZcMVMN199quUA0&dib_tag=se&keywords=cgp+step+up+to+a+level+biology&qid=1719570230&srefix=cgp+step+up+to+a+level+biology%2Caps%2C72&sr=8-1



TB or not TB?

Badgers, cattle and tuberculosis

Above: Dairy cattle, the victims of bovine TB

Inset: This badger cub may have died of TB, or as a result of illegal badger digging.

When cattle are found to be suffering from tuberculosis, a disease which can be passed on to humans, they are routinely slaughtered. It is known that badgers can transmit the disease to cattle, so many farmers would like to see badgers culled. But is this the solution to the problem? A recent scientific study suggests that it is not.

Badgers, cattle and TB

In 1971, a farmer in Gloucestershire found a dead badger on his land. The farm was in an area where cattle commonly suffered from bovine tuberculosis (bTB). On examination, the badger was shown to be infected with *Mycobacterium bovis*, the bacterium which causes bovine tuberculosis (see Box 1). Ironically, cattle make an area a better habitat for badgers by increasing earthworm numbers and giving rise to short grass, which badgers favour for foraging. Badgers also like to eat silage, a type of cattle feed.

It is not fully clear how the disease is passed from badger to cattle, although the eating of urine-contaminated grass seems to be the most likely way. Contagion (that is, spread by actual contact) is unlikely since badgers and cattle avoid each other.

Starting in the 1970s, badgers were culled in areas where cattle seemed to be under threat. This was first carried out by gassing with cyanide, but it was discontinued in 1981 when trapping and shooting became the favoured method.

Aside from the wish to keep a domestic animal disease free, why are people worried about TB in cattle? Firstly, there are forms of TB which humans can get from cattle. However, the major worry is economic. UK policy is that any cattle which test positive for TB (they are called reactors) are slaughtered. Farmers are paid compensation for this, but there is a human cost to a farmer in seeing his herd wiped out. There is also a cost to the government, and therefore the taxpayer. In the two years 2002-3 and 2003-4 the total cost to the UK taxpayer was over £160,000,000. Numbers of cattle involved can be seen in the graph in Figure 1.

Box1 What is TB?

Tuberculosis (TB) refers to a range of diseases all caused by bacteria of the genus *Mycobacterium*. In humans a lung disease (pulmonary TB), commonly simply referred to as TB, is caused by *Mycobacterium tuberculosis*. In cattle the villain is *M. bovis*, causing bTB. Humans can get this from cattle, and it causes mainly a disease of the membranes of the brain, the meninges, called meningial TB. In humans, cattle and badgers it can be vaccinated against, although with nothing like 100% success. It is also treatable with antibiotics, but again, not easily. The disease is very serious, causing many deaths in all species.



Mycobacterium bovis, the bacteria responsible for bovine TB, seen with a transmission electron microscope.

Dr Linda Starmard, UCT/SPL

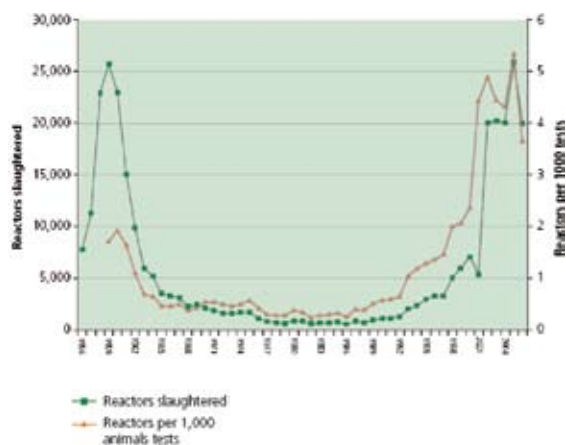


Figure 1 Number and rate of tuberculin test reactors disclosed annually in Great Britain (from the Bourne Report, 2007).

Calling culling into question

In some areas, culling was followed by a great reduction in cases of bovine TB. So, with this apparent success story, many farmers were shocked to read this in a recent report:

After careful consideration of all the RBCT (Randomised Badger Culling Trial) and other data presented in this report, including an economic assessment, we conclude that badger culling cannot meaningfully contribute to the future control of cattle TB in Britain. **(The Bourne Report, 2007)**

What reasons can there be for not culling badgers? First of all, of course, the general public objected to the mass killing of badgers. However, this is not a scientific reason to reject the idea of culling. The Bourne Report was an attempt to give an answer to the scientific question:

- Can the culling of badgers reduce the transmission of bovine TB to cattle?

The Bourne Report

Here is how the Independent Study Group (ISG) of scientists went about answering this question. They first decided to have three sorts of trial area:

Reactive culling: Badgers culled in response to an outbreak of bovine TB.

Proactive culling: Badgers culled to try to prevent an outbreak.

Survey-only: A control area.

Each area was about 100 km², circular to reduce 'edge effects' (Figure 2). In addition, each had inner and outer buffer zones to minimise any likelihood of badger territories overlapping between the different treatments. These buffer zones were 1km wide, a figure based on the maximum 'ranging distance' of a badger which had been found out in earlier work. Each group of three treatments was

called a triplet and ten such triplets were studied over the nearly seven years of the study. This makes 30 areas in all, the three treatments being assigned to each area randomly. The scale of this work can be appreciated by the fact the proactive culling programme involved 160 000 trapping nights and the reactive 25 000 trapping nights. Just over 10 000 badgers were killed.

All of them were located in the South-West of England, where the main difficulties with bovine TB have been for decades past (Figure 3).

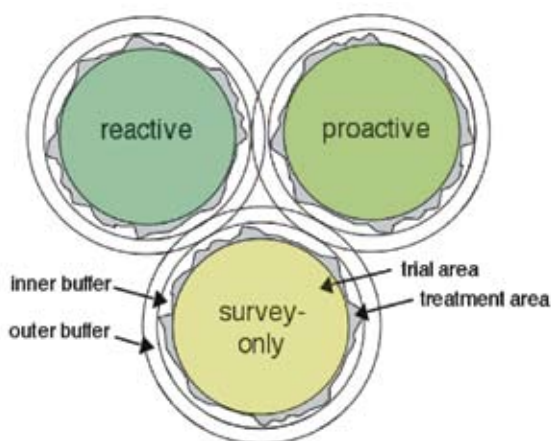


Figure 2 A triplet of study areas

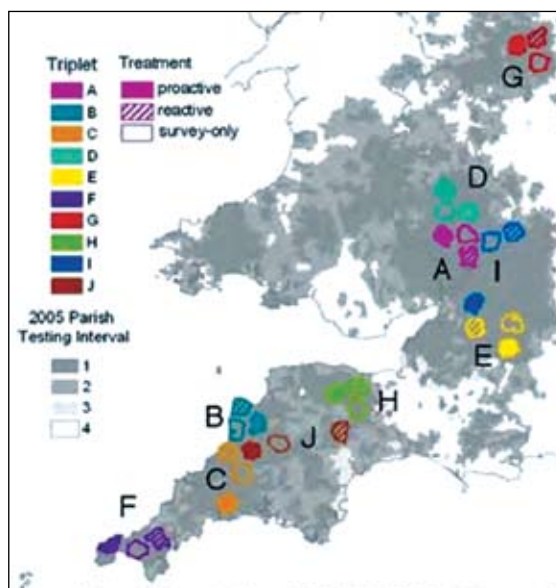


Figure 3 Location of randomised badger culling trial study sites (from the Bourne Report)

The UK Government set up the Independent Study Group of seven scientists. Their final conclusions appeared as the Bourne Report.

What they found out

- Culling had a large effect on badger populations, lowering them by about 75% in culled areas.
- Reactive culling had a detrimental effect, that is, it led to an increase in bTB in cattle.
- Proactive culling led to a reduction in bTB cases in the culled areas, but it led to an increase in its incidence in nearby areas, an effect which seemed to cancel out any positive benefits more-or-less exactly.

Many country people were unhappy with the Bourne Report's findings, as these comments on the BBC's Farming Today website show:

"Why all this nonsensical language about 'wild-life reservoirs'? As to bovine TB, the answer is all too clear: Kill all the badgers; let not one survive. And all the lovers of 'The Wind in the Willows' can go and top themselves. What romantic nonsense! The welfare of our hard-working farmers surely comes first. Their cattle deserves to be disease-free."

"We have a very large population of badgers in North Devon. Bovine TB is a big problem round here, with most farms getting re-infected despite culling of infected cattle and testing of replacements. The State vets tell us that infected badgers are the cause, and it certainly can't be cattle to cattle transmission. I just hope that they introduce a badger cull round here."

Interpreting the results

So, what is going on? Culling seems to have an effect on the complex ecology of the badgers and this leads to an increased likelihood of transmission of the disease to cattle, rather than the hoped for decrease. In culled areas, badgers move around more with some coming from outside the area to re colonise it and those in the area simply ranging further afield. As the report summarises:

These pieces of evidence strongly suggest that proactive culling provoked increased immigration, greater contact rates among badgers and, as a consequence, increased transmission of *M. bovis* infection among badgers.

The report predicts that culling would give a reduction in outbreaks of 116 in culled areas, but, because of the effect on badger behaviour, lead to 104 more cases outside. The difference is very small,

and not in fact significant. The report's authors concluded that they could not be confident of any improvement at all, and this is in the light of the huge effort described above.

The ISG's cost benefit analysis suggests that the culling of badgers is simply not a cost effective means of controlling bovine TB.

So, for the moment, the much-loved Brock the Badger seems to be safe. But what other solutions are there? Bourne is only cautiously optimistic about a vaccine for TB. He stresses the importance of even more careful control of cattle movements and thus the reduction of cattle-to-cattle spread. This, along with immediate eradication of reactors, is the most efficient means of control, even though it costs a lot of money.

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Paul Avis/SPL

Testing a cow for TB: a vet injects tuberculin into the cow's neck and then looks for an allergic reaction.

Box 2 Testing for Tuberculosis

In both humans and cattle, where it is important to find out if they have encountered TB, a simple allergy test is done. A small amount of TB protein is introduced under the skin. Inflammation, showing up as a swelling, shows that an immune response is possible, and that immunity to TB exists (in humans). In this case a BCG injection would not be offered. In cattle, a positive reaction (the animal is said to be a *reactor*) would signal bovine TB and, in the UK, the animal would need to be slaughtered as part of the policy to prevent spread.

A Level Biology → Y11 into Y12 Transition work

- The aim of this task is to develop your skills of reading articles and extracting relevant information
- Use the article TB or not TB? To answer these questions

Part A Bibliographic details

1 Write down the following bibliographic details of the article:

Title: _____

Year of publication: _____ Place it was published: _____

2 Who is (or are) the author(s)? _____

Are they experts in this field? How do you know? _____

3 What further information can you give about the author(s) (e.g. location, occupation, qualifications)?

Part B Looking at the article

Write down where you found the answers (i.e. which page/paragraph in the article) AND the answers to the questions themselves!

1 Why is TB in cattle of concern to humans?

2 What is the difference between TB and bTB in humans?

3 How can you test humans for TB infection? _____

4 How many cattle were slaughtered in 2002 as a result of being tested for TB?

5 What is the UK policy on dealing with 'reactors'? _____

6 How did the scientists in the Independent Study Group (ISG) organise their study?

7 What was the question being addressed in the Bourne report?

8 Why did most of the study take place in S.W. England?

9 Does badger culling have a statistically significant effect?

10 What type of analysis did the ISG use to decide whether or not to recommend badger culling as a preventative measure for TB?

Part C Evaluation

11 Do you think this is a scientifically useful article? Explain your answer.
