INTEGRATED SURVEILLANCE SYSTEMS

New Zealand's bovine TB management policy aims to achieve full biological eradication of the disease by 2055[1].

To support this goal, TB managers make decisions based on scientific knowledge about TB levels in wildlife and livestock. This allows them to identify if and where TB might persist in wildlife, and decide whether to continue management or cease on the basis that eradication has likely been achieved.

To that end, New Zealand's TB management approach will increasingly be governed by the knowledge supplied by integrated surveillance systems regarding the disease status in wildlife and on farms.

WHY INTEGRATED SYSTEMS ARE REQUIRED

As a result of 20-plus years of sustained effort in TB control, New Zealand has reduced its TB rate in livestock by over 97 per cent. A very large part of this has been attained by controlling populations of wildlife TB vectors (primarily possums, the main wildlife host), which has greatly reduced the threat of transmission of infection from sick possums to cattle and deer.

The challenge for the coming years is to identify whether TB has truly been eliminated from possums in a given area or merely 'suppressed'; in other words, evaluate the risk that TB might persist at very low levels (at which it is extremely difficult and costly to detect), only to re-emerge at some point in the future.

The key to being able to affordably check for TB persistence lies in obtaining and using surveillance data from multiple sources.

Surveillance means acquiring information on the disease status of the species of interest, as well as more general biological information about that species. Traditionally, and currently, managing TB in New Zealand has involved acquiring such information via necropsy surveys of those wildlife species that can act as vectors of infection, especially possums.

In an area where the TB status is questionable, possums are trapped, killed and then examined via necropsy for signs of the disease. The problem is that TB often persists at very low levels in possums, making it difficult to detect. Moreover, in areas where possums have been controlled there are very few of them left, so trapping sufficient numbers to make a sound decision about what management action to take is time-consuming and costly.

Integrated surveillance systems gather information from many different sources in addition to TB in possums – including information on other wildlife species, the recent history of local possum control and expected possum population dynamics, TB-testing data from livestock in the area – and combine these to produce a composite output so that managers can identify the best next step.

The output is produced by a computer modelling system, which has been developed by managers and researchers at OSPRI and Landcare Research[2].

WHAT KIND OF INFORMATION IS EVALUATED?

A major component of the information entered into computer models is based on possums. Field surveys provide an indication of possum population levels, and necropsy surveys give an indication of TB status. In addition, information on how much the possums move in this habitat is used, mostly from prior knowledge, but sometimes by fitting possums with radio-tracking collars. Information from other wildlife 'sentinel' species (i.e. those that carry but don't ordinarily transmit infection) is also used.

Pigs provide high-quality sentinel information, which can be acquired by shooting and examining resident wild pigs or by purposely releasing pigs that can be recaptured later. The TB status of pigs is assessed, and the age of individuals is estimated to help determine whether TB infection might be recently-acquired or historical. As with possums, pig home-range movements are incorporated into the computer model to account for the area they cover and where they may have acquired TB. Among other wildlife, ferrets are often trapped, killed and used as TB sentinels in open grassland environments, while deer are sometimes used as sentinels in heavily forested habitats where there are few pigs or ferrets.

Surveillance data is also available from livestock testing from two sources:

- results of on-farm TB testing of cattle and deer
- carcass inspection for TB through meat inspection at routine slaughter at processing premises. Both methods have been assessed as having a high probability of detecting TB if present under New Zealand conditions.

TB 2055

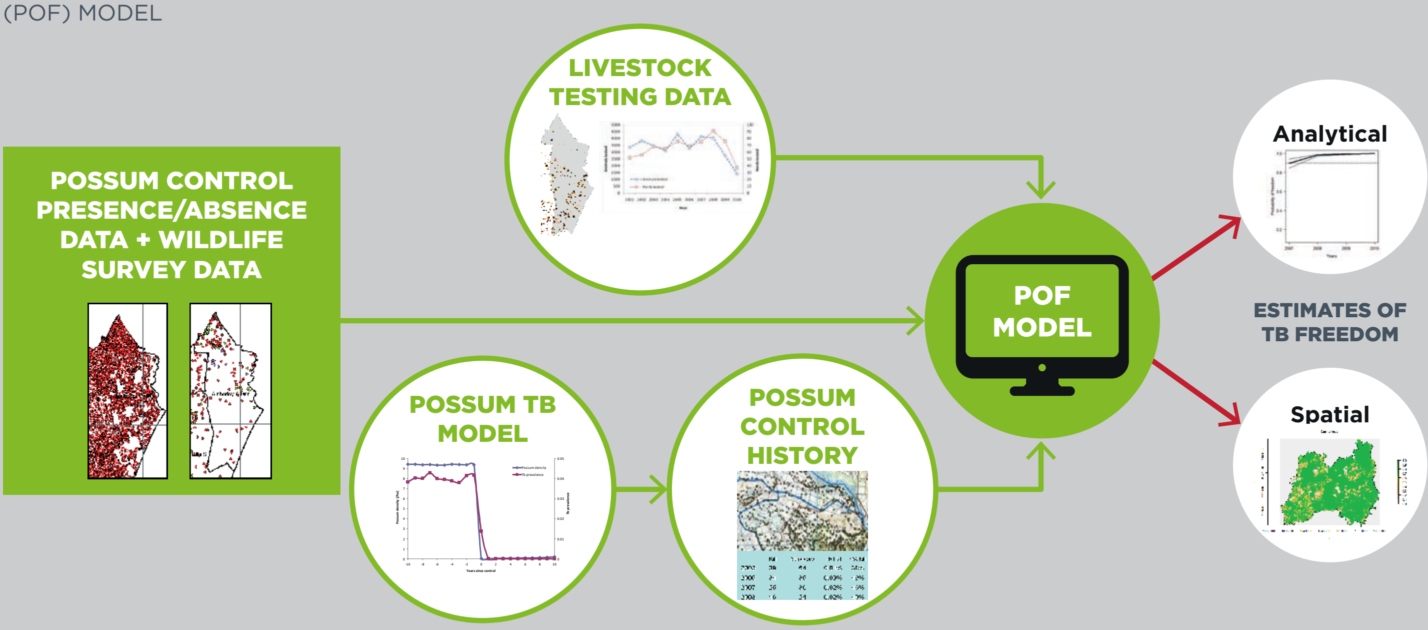
NEW ZEALAND'S BOVINE TB MANAGEMENT PROGRAMME AIMS TO ACHIEVE

FULL BIOLOGICAL ERADICATION OF THE DISEASE BY 2055

Therefore domestic cattle and deer are very effective sentinels of TB infection in wildlife on farmland ("Livestock-as-sentinels") and are progressively being incorporated into the computer models.

Finally, information about the area under consideration is also used in the computer model: how recently the wildlife was controlled, what the possum numbers and TB levels were before and after control, and (in a recent development) information from the diagnostic screening history of livestock in the area (i.e. the skin- and blood-test results from cattle and deer, and the dates they were tested, along with the animals' final TB status, as determined by abattoir inspection).

PROOF-OF-FREEDOM FRAMEWORK
(POF) MODEL



WHAT INTEGRATED SURVEILLANCE SYSTEMS TELL TB MANAGERS

The combined information is processed using a computer software package called the 'Proof of Freedom (PoF) utility'. The output gives the TB manager a probability that TB has been eradicated from the area of interest, and sets confidence bounds around this so that the potential for error can be evaluated. The manager then uses this information, together with his/her personally-acquired knowledge of the area, to make a decision on the next course of action, which will balance the desired outcome (certainty that TB has been eradicated) against affordability (the costs associated with reaching that knowledge point).

In New Zealand's TB eradication programme, each local management area (Vector Control Zone; VCZ) is judged on its own merits, but the decision will be added to the composite picture of what is happening across the country. So far, since its first implementation in 2011, running the PoF utility on integrated surveillance data has contributed to over 1.6 million ha of New Zealand being designated TB-free rather than infected[3].

Overall, an integrated surveillance approach allows managers to make informed decisions about future courses of action. It allows them to decide what form of management is required (i.e. more control effort, further surveillance, or both) and lets them evaluate when enough has been done to achieve TB eradication with confidence (having good 'stopping rules'). The use of multiple sources of diverse surveillance information has the effect of increasing accuracy for future predictions and reducing costs (with less reliance on trapping and necropsy of possums alone, when numbers are low and TB is scarce).

SCIENTIFIC REFERENCES

1. The new plan to tackle TB. 2016. OSPRI/TBfree information bulletin. www.ospri.co.nz/assets/Uploads/Documents/The-New-Plan-to-Tackle-TB.pdf.

2. Anderson DP et al. 2013. A novel approach to assess the probability of disease eradication from a wild-animal reservoir host. *Epidemiology & Infection* 141(7): 1509-1521. http://dx.doi.org/10.1017/S095026881200310X.

3. OSPRI media release 04/7/16. Nearly 1.6 million hectares declared free of bovine TB. www.ospri.co.nz/news-and-events/news/nearly-1-6-million-hectares-declared-free-of-bovine-tb.

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FURTHER INFORMATION

- Watch short videos at **ospri.co.nz** on Wildlife Surveys; How Wild Pigs help track TB; How Ferrets help track TB.
- For more information on the role of possums as vectors of TB, and the ways in which information used in integrated surveillance systems is gathered and processed, visit **ospri.co.nz**.
- For detailed scientific explanation of integrated surveillance systems for TB, see the publication by Anderson et al. in the *New Zealand Veterinary Journal* at www.ncbi.nlm.nih.gov/pmc/articles/PMC4566888/pdf/tnzv-63-089.pdf.