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THE ERADICATION OF BOVINE TUBERCULOSIS FROM INFECTED WILDLIFE POPULATIONS: A NEW ZEALAND SCENARIO

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Abstract: The Animal Health Board (AHB) is the agency responsible for controlling bovine tuberculosis (Tb) in New Zealand. In 2000, the AHB embarked on a strategy designed to reduce the annual period prevalence of Tb infected cattle and farmed deer herds from 1.67% to 0.2% by 2012/13. Under current rules of the Office International des Epizooties (OIE) this would allow New Zealand to claim freedom from Tb. The epidemiology of Tb in New Zealand is largely influenced by wildlife reservoirs of infection and control of Tb vector populations is central to the elimination of Tb from New Zealand's cattle and deer herds. The AHB has classified New Zealand's land area into Vector Risk Areas (VRAs) where Tb is established in wildlife (currently 39%) and Vector Free Areas (VFAs) where the disease is not established (61%). Within the VRAs the introduced Australian brushtail possum (*Trichosurus vulpecula)* is the primary wildlife maintenance host and the main source of infection for domestic cattle and deer herds. Southland is a region of New Zealand with a long history of wildlife associated Tb. Progress in reducing infected herd numbers has been impressive in recent years, primarily due to an intensive possum control program. As a result of this reduction, the focus is now shifting to that of providing increasing levels of confidence that Tb is absent from the remaining susceptible wildlife. High levels of confidence of Tb freedom in wildlife will allow the AHB to reduce the wildlife control programs and ultimately cease control altogether, with minimal risk of Tb re-emerging. This paper examines the strategies being utilised to provide that confidence. The types of data, the format in which it is collected and the methods of analysis and review are outlined.

Key words: Animal Health Board, bovine tuberculosis, datasets, domestic cattle and deer herds, National Pest Management Strategy, New Zealand, proof of freedom, surveillance, Tb vectors, technology, vector control

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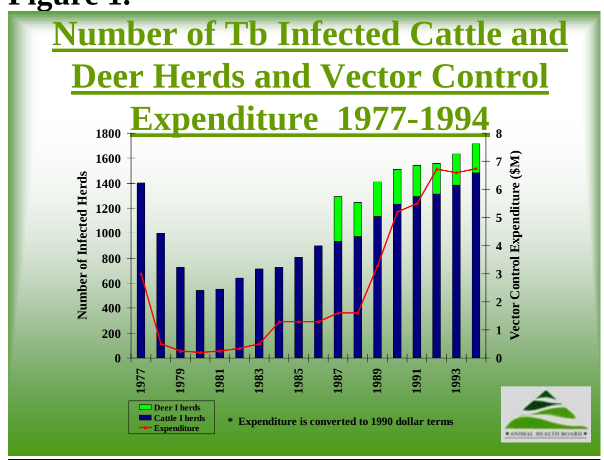
INTRODUCTION

Bovine tuberculosis (Tb) has been recorded from a variety of wild animal species within New Zealand. Wild animals that carry *Mycobacterium bovis (M. bovis)* and which can infect other wild animals, or farmed cattle and deer, are called Tb vectors. Spread from Tb vectors to farmed livestock is through intimate contact between terminally diseased vectors and inquisitive, dominant cattle or deer. Areas that are known or suspected of harbouring Tb vectors are referred to as vector risk areas (VRAs) and areas considered to be free of Tb vectors are called vector free areas (VFAs).

In 1956 wild red deer (*Cervus elaphus)* were found to be infected with Tb (de Lisle et al. 2001) and in the 1960's wild pigs (*Sus scrofa)* were diagnosed with this disease (Ekdahl et al. 1970). During 1967 Tb was found in a brushtail possum (*Trichosurus vulpecula).* By 1970 all dairy herds in New Zealand were subject to compulsory Tb testing with the slaughter of any reactors and by 1977 all beef cattle were being monitored for the disease by testing or by slaughterhouse inspection. Great success was made with controlling Tb in the national cattle herd, except for one area, the Buller District on the West Coast of New Zealand where little or no progress was made. In this area progress at clearing cattle herds of Tb infection was only made after intensive control of the resident brushtail possum population. This was the first time that a wild animal had been identified as being a significant Tb vector in New Zealand. It is believed that the local possum population originally became infected from tuberculous cattle. In recent years, the cause of more than 90% of all new and persistent cattle and farmed deer herd Tb infections in New Zealand has been attributed to Tb vectors, primarily the possum.

Uncontrolled possum populations can remain infected without the need for further contact with other infected species. Thus, they are a true maintenance host for bovine Tb (Morris and Pfeiffer 1995). Other Tb vectors have been identified, the most significant being the ferret (*Mustela furo)* and wild deer, primarily red deer (*Cervus elaphus)* and fallow deer (*Dama dama).* Ferrets and wild deer are considered to be of secondary importance as Tb vectors and largely spillover hosts from infected possum populations. In the few areas where ferrets occur at particularly high densities these animals may be acting as maintenance hosts (Caley 2002). Feral pigs and wild cats can and do contract Tb by scavenging dead carcasses but are considered to be dead-end hosts. However, the liberation of wild pigs to extend and enhance hunting opportunities is believed to occur quite frequently and some of these animals are probably infected with *M. bovis.* Heads and viscera from pigs that are shot or die from other causes are available to be scavenged by ferrets and possums. This could result in the introduction of Tb to previously uninfected wild animal populations and the expansion of the VRAs. Possums were originally believed to be strict herbivores but subsequent studies have shown that they will also consume some meat from carcasses (Caley 1998, Ragg et al. 2000). Brushtail possums, ferrets, feral pigs and feral deer have been introduced to New Zealand and are considered to be pest species.

Figure 1.

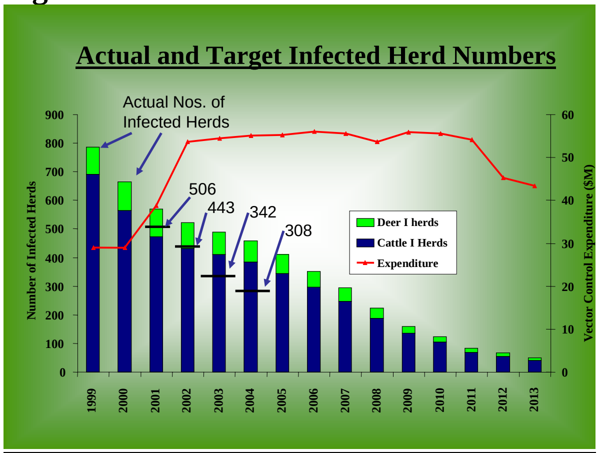


Once the possum had been demonstrated as being the principle Tb vector in New Zealand, widespread possum control was instigated across the four VRAs that were known at that time. As a direct result of this work the number of infected herds reduced dramatically. However, from 1978 the expenditure on possum control was prematurely reduced to minimal levels. By 1980 the decline in infected herd numbers had bottomed out and began to rise again the following year, continuing to reach a new peak of more than 1700 infected herds in 1994 (Figure 1). Even though possum pelts provided a good financial return at this time, skin hunters were unable to have any real effect on overall population numbers once organised culling activities were curtailed. Possum control for Tb purposes requires a reduction in animal density to a level far below that where it is economic for skin hunters or bounties to be cost effective.

By the early 1990s it was clear that a strategy was needed to ensure New Zealand progressed toward the long-term goal of bovine Tb eradication if the risk of Tb related non-tariff trade barriers for beef, venison and dairy products was to be minimised. After widespread consultation the National Tb Pest Management Strategy (NPMS) came into force during 1995 with the Animal Health Board being the agency responsible for implementation, technical management, research, and administration. Tb vector management was contracted out by the AHB on a regional basis to competent agencies (vector managers). The NPMS easily achieved the 5 year objective of dramatically reducing infected cattle and deer herd numbers. The actual number of infected herds for June 2000 was 666 (0.92% of all cattle and deer herds) compared with the strategy forecast of 1092 (1.5%) infected herds for June 2000. However during this period four new VRAs were defined and 22 extensions made to existing VRAs. Tb was still spreading in the wildlife population.

In 2000 the NPMS was amended and new objectives were set, with the key target being to reduce the number of infected cattle and deer herds to 0.2% annual period prevalence by 2013 (Figure 2). To achieve this goal it was estimated that Tb vector densities would need to be severely reduced and maintained at low levels over more than 8.4 million hectares (32%) of New Zealand, with the average annual expenditure on vector control activities being approximately $53 million per annum until 2013. While this was a huge increase over previous levels of expenditure it was still insufficient to provide vector control for all risk areas simultaneously. If the amended strategy was to be successful Tb would need to be eradicated from some VRAs during the life of the strategy so that vector control could stop in those areas and funds diverted to other risk areas.

Figure 2.



BOVINE TUBERCULOSIS IN SOUTHLAND

Southland is a region of New Zealand that has a long history of wild animal related Tb herd infections. Recent progress has been steady and the total number of infected herds is projected to be less than 12 for June 2005, well down from the 50 recorded for June 1996. All current infected herds are now associated with only one of the four VRAs in the region. During 2004 a large section of one VRA was revoked and other areas are approaching eligibility for revocation. Two key criteria need to be satisfied before a VRA can be considered for revocation. Firstly, there must have been no new cattle or deer herd infections due to local wildlife for at least 5 years. Secondly there must have been intensive wild animal surveys for at least the last 2 years with no Tb detected in the wild animals sampled. Throughout New Zealand few VRAs have been revoked and very few vector control operations have been stopped completely.

The ability to effectively manage Tb in Southland is substantially enhanced by the quality and scope of historical information that has been collected. This information is stored as either an Access or SQL database that contains a detailed history of disease control activities performed during the last 8 years. Data is collected from multiple sources and is consistent in format and definition to provide compatibility with existing information. New technology such as Personal Digital Assistants (PDAs) and new generation Global Positioning Systems (GPS) equipment has aided the accurate and consistent collection of data. Information can then be displayed in various ways (spatial, temporal, quantitative and descriptive) for interpretation and analysis to assist in critical decision making.

POSSUM CONTROL

Possums are a true maintenance host for *M. bovis* and by far the most important Tb vector in New Zealand. Extensive modelling studies have demonstrated that if possum densities are maintained at very low levels and the residual possums are evenly distributed throughout the available habitat then Tb, if present, will die out of that possum population with a high degree of probability (95%) within 5 years (Barlow 2000). Residual possum densities are estimated using a scientifically based and nationally accepted protocol and represented as a Residual Trap Catch Index (RTCI). The activity of estimating RTCIs is called possum monitoring. Lines of ten possum traps are randomly allocated throughout potential possum habitat within the area of interest and the number of possums caught over a 3 night period is expressed as an RTCI. All possums captured during monitoring are killed. An RTCI of 2% or less (2 or fewer possums caught per one hundred trap nights) is considered to represent a low density of possums. RTCIs above this level extend the time to Tb eradication beyond 5 years and with average RTCIs exceeding 5% eradication is unlikely to be achieved. To ensure that the residual possums are evenly distributed the maximum number of possums that can be caught on any one line can be specified (line maxima). The combination of a mean RTCI maximum and associated line maxima comprise the primary specifications for a possum control operation. Work is tendered and awarded to the most competitive eligible contractor. Contractors decide on the control methods that they will use, but the land owner must agree. Contractors are paid only when they achieve the required outcomes, with significant financial penalties if more than one attempt is required. No payment is made if the outcomes are not met.

Areas requiring possum control are identified using herd and wildlife information. These are primarily the VRAs and surrounding buffer zones designed to prevent the outward spread of Tb via wild animal migration. The areas are defined and stored electronically using Geographical Information System (GIS) software. The perimeter of a control block defines the area that will be monitored. A process referred to as stratification is used to further subdivide the control blocks according to habitat types and disease risk. Habitat strata are defined as bush, bush-pasture margin, farmland or tussock. Disease risk strata are classified as high or medium. High risk areas are usually associated with herds that have been recently (up to 3 years previous) infected from local wildlife or the finding of a Tb wild animal. Exact boundaries are determined from a combination of topographical maps, aerial photographs, a land cover database (LCDB), satellite images, physical inspection and local knowledge. Stratification ensures that monitoring lines will be placed throughout all risk areas with a special emphasis on assessed high risk areas. High risk areas receive one and a half times the standard number of monitoring lines. Prior to tendering for work, contractors are informed of the number of monitoring lines that will be placed within each strata, but not the line locations. These lines are randomly placed within potential possum habitat within each strata to measure the contractors performance and hence eligibility for payment. Intensive stratification together with low RTCI and line maxima targets provides the greatest surety that contractors will work all potential possum habitat within the area. If the contractor fails to achieve the required outcomes within a set time frame no payment is made. These contracts are referred to as performance based. Such contracts are a relatively coarse tool but work very well during the early and mid-stages of a Tb control programme. Contracts that specify activities for contractors to perform, such as setting traps on a grid basis or using a particular toxin type, are used when very low RTCIs have been achieved but disease persists in the wild animal populations. With specified activity contracts, contractors tender for work based on completing specified activities in a contract but bear no responsibility for the residual density of possums achieved.

Regardless of the contract type, possum control contractors are required to record the location, using GPS, of each possum control device used (usually a toxin or a trap), its type and length of time that the device was active and the habitat type that each device was located in. All sites where a capture or bait interference event occurred are recorded. Target animal data such as the date of capture, sex and weight are recorded. Any animals that show visible lesions or other suspicious signs of tuberculosis must be recovered for post mortem inspection. All data is appended to the possum and ferret control database.

POSSUM POPULATION MONITORING

When a contractor has completed working a performance based contract, a post-control monitor is performed. Monitoring of possum densities post-control serves two purposes. Firstly it provides a scientifically based and accepted means of measuring a contractors performance against control specifications. Payment is only made when and if the contract specifications have been attained. Secondly, monitoring allows the calculation of the likely time to eradication if one assumes that the residual possums are evenly distributed throughout the area and the rate of immigration can be estimated. The RTCI provides an estimate of the residual possum population, not a measure of the kill rate. For the purposes of Tb control and eradication, low even possum densities are required, regardless of the initial population levels. Resources are therefore not normally allocated to measuring possum densities prior to control in areas where it is suspected that densities will exceed 2% RTCI.

During the design of a possum monitor all potential possum habitat is identified within each strata, using information from satellite images (Ecosat), aerial photographs, a land cover database (LCDB), topographical series maps, and ground truthing (physical inspection). The identification and mapping of all habitat is a critical activity as monitoring lines are randomly placed only within potential habitat. If habitat is not identified it will not be monitored. A customised GIS application uses datasets to generate all potential monitor line start points and determines the number of monitor lines for each strata based on criteria provided. The application then randomly selects the required number of monitoring lines from all potential lines available. Selection criteria can be modified based on need, for example, by accessing all past records the program can be set to exclude monitoring lines that have previously been used. The exclusion criteria can be by time and or distance. The coordinates for the selected start points are sent electronically to the monitoring contractors who upload these to their GPS. Using software provided by the vector manager an electronic data entry and record form is also provided to the contractor via e-mail. The contractor is required to complete this electronic form and e-mail it back to the vector manager where it is appended to the possum monitoring data base. Electronic data checks are used to verify the completeness of the data entered by the contractor prior to e-mailing to the vector manager. A second electronic check is performed by the vector manager prior to appending to the database. This process provides for increased efficiency, accuracy and convenience for the contractor and vector manager. Contractors can also audit the performance of their own staff using these tools, thus helping to ensure complete control coverage.

FERRET CULLING

Ferrets are considered to be vectors of bovine Tb although generally as spillover hosts. However, when there was a relatively high rate of infection in ferrets they were culled to reduce the herd breakdown rate, even though they were not implicated as maintenance hosts. Unlike possums there is no scientifically accepted practical and cost effective method for estimating ferret densities. Therefore, ferret culling contractors were paid based on effort (specified activity) measured as the number of traps set per night. With the current low levels of infection in ferrets (9 from 1076 post mortemed during 2004) the primary purpose of ferret capture is now for Tb surveillance. Ferret culling contractors were required to collect the same type of data as possum control contractors and all data was appended to the possum and ferret control database.

WILD ANIMAL SURVEILLANCE

Wild animal surveillance is undertaken for two primary purposes, to determine the geographic distribution and prevalence of infected wild animals and or to provide evidence of Tb absence in wild animal populations (proof of freedom). Large areas of Southland have now had 5 years freedom from Tb vector related herd infections. The decision to cease vector control is based on the level of confidence that Tb is no longer present in the wild animal populations of the area. Within Tb infected wild animal populations the prevalence of possum infection is often extremely low (1% or less). However, scavenger species such as the ferret and feral pig are very good indicators of Tb infection in sympatric possum populations (Nugent et al. 2002) and where present, are targeted for wild animal Tb surveys. However, the translocation of wild pigs by humans is suspected to be quite common so care needs to be taken when interpreting the significance of Tb infected feral pigs. Possum surveys may be used when the scavenger species are absent or present at very low density. Wild deer occur throughout New Zealand and are occasionally targeted for wild animal surveys when the scavenger species are absent. Feral deer are not considered to be maintenance hosts for bovine Tb in New Zealand due to their relatively low population density and habits. However they have been recognised as providing value as indicators of Tb in possum populations (Coleman et al. 2000).

When Tb is at a very low or nil prevalence in a low density population, the sample size required to provide a high level (95%) of confidence of the true disease status of that population approaches that of the population size itself. That is, virtually all of the members of the population need to be sampled. In heavily controlled wild animal populations this presents a dilemma in that the density of the target wild animals is always going to be low. In addition, mature remaining individuals are more likely to show aversion to existing control techniques as demonstrated by their ability to avoid capture to date and the toolbox of control methods is restricted to acute lethal techniques as the carcasses are required for post mortem inspection. As a consequence these surveys are always going to be expensive when cost is measured against the number of animals captured.

In Southland very good quality RTCI data exists for all areas of interest. RTCI provides an estimate of possum density and this can be translated into an estimated absolute number of possums per hectare (Ramsey and Ball 2004). Calculation of the probable population size and the required sample size is then relatively straight forward and can be taken down to the strata level to provide an accurate estimate of the spatial distribution of the population. The only limiting factor is the ability of current techniques and contractors to deliver the required number of animals at a reasonable cost. Ferret density estimation has proved problematic with no reliable method having been described that is also practical for widespread use in the field. Existing methodology is complex and involves calculation of trap catch rates and capture-recapture data (Norbury and Efford 2004). Estimating pig populations is similarly fraught with difficulty. The determination of target sample size for scavenger species surveys is estimated using the wealth of previous experience with that population. Deer populations also provide challenges for density estimation but the large amount of historical data allows for what are probably reasonably accurate estimates to be made. During surveys contractors are required to regularly communicate device locations and capture rates to the vector manager. This data is immediately mapped to ensure adequate geographical coverage is being achieved. Capture rates are analysed and the contractor is then directed as to how much effort to expend in each location. This provides for dynamic survey management with fine-tuning of design parameters during the period of the survey.

Areas for wild animal surveys are identified and mapped using the same techniques as described for possum control and monitoring. For all surveys, samples are sought from throughout the area of interest to ensure a good geographical spread of data. Specifications are set and contracts tendered. Data collected from all surveys includes the species captured, location of capture (GPS), capture method, device location and the period of activity of all capture devices. Animals collected are uniquely identified, referenced to the capture site and returned to the laboratory for detailed post mortem inspection. An autopsy database receives and stores the data from all wild animals that are post mortemed.

CATTLE AND DEER HERD TB TESTING INFORMATION

Cattle and deer herd testing data is imported from an external database. This includes information on herd type, herd location and Tb testing history. Infected herds are categorised according to the cause of infection which could be from a local wild animal or bought-in from another herd.

ATTITUDE TO TECHNOLOGY

There has been resistance from contractors to use more advanced location and recording technology (computers, PDAs and GPS). The initial resistance was reduced when the advantages and benefits were demonstrated. Today, most have embraced the new technology and are keen to upskill to meet future customer requirements. The vector manager has deliberately designed systems that can be operated by contractors using basic hardware with internet access. The vector manager provides initial training and ongoing support. Data is forwarded electronically to the vector manager where all the serious computing power is housed.

DATA ANALYSIS AND DECISION MAKING

All data collected from the field activities described is appended to one of the vector managers databases and reports or queries are drawn from here. Data is exported from the database as a file that is best described as an attribute table. Attribute tables can be amended to update program plans. The file can be opened using GIS software (ARC GIS) which can then display this as a table, or as a view. A view is a spatial representation of the information contained within the table. ARC GIS software can use a variety of datasets that may be points, shapes or images. Layers of these datasets can be presented to display a spatial and or temporal outcome for interpretation. The ability to view datasets in numerous combinations provides the technical design and review team with an efficient way of analysing and interpreting the large amount of information that would have previously been locked up in a written form (reports and maps). Regularly used datasets include infected herd information, RTCI, wild animal surveillance data, device locations, wild animal capture sites, shapefiles of control work boundaries, topographical maps and photographic images. Ready access to quality data assists with the early detection of warning signs that the programme is not delivering expected outcomes. Planning efficiency and determining future needs and actions are enhanced.

Nationally, the efficient use of vector control funds is essential if the NPMS objectives are to be met. The RTCI monitoring tool has been the cornerstone of achieving results to date. Reducing possum densities below 2% has led to impressive reductions of infected herds throughout New Zealand. In Southland there has been evidence that when low RTCIs have been achieved performance contracts can become financially inefficient. Contractors are aware of the previous years RTCIs before tendering for work. There is a serious risk of little or no possum control work occurring under a performance contract when previous RTCIs are very low and there has been negligible risk of immigration due to good control in adjacent blocks. A contractor could call for a monitor, pass and thereby get paid after having done little or no work because the contract block already met the required specifications prior to work being tendered. There are a number of options available to manage this situation, including the use of precontrol possum monitoring to check possum densities prior to further decisions being made, deferring possum control for a specified period (usually one year) without a pre-monitor, targeting control to areas considered most at risk, specifying activities for contractors to do (specified activity contracts) or deciding that Tb is eradicated and stopping possum control. There are a number of option specific key criteria that must be satisfied before a strata can be considered for any of these options (Table 1).

Table 1. Option Specific criteria evaluated before selecting a strata for possum control.

Parameter	Precontrol Monitoring	Deferred VC	Targeted VC	Specified Activity Contracts	Stopping VC
RTCI	3 years <2%	3 years <2%	3 years <2%	Not applicable	5 years <2%
Line maxima achieved	Previous 3 years	Previous 3 years	Previous 3 years	Not applicable	Previous 5 years
No local Tb vector herd infections	Previous 2 years	Previous 3 years	Not applicable	Not applicable	Previous 5 years
No local Tb vector infections	Previous 2 years	Previous 3 years	Not applicable	Not applicable	Previous 5 years
Adjacent strata meet same criteria	Not required	Not required	Not required	Not required	Required

* VC = vector control

Premonitoring or deferring vector control only occurs when the required specifications have been met and there is no persistent disease within herds or Tb vectors in the area. Targeted control is used to focus in on those areas within strata where disease persists in wildlife despite low RTCIs and line maxima targets having been achieved. This work can be managed as either performance based or specified activity contracts, depending on which is the most efficient for the situation. Specified activity contracts can also be used for low RTCI areas or where the required residual density of possums has not been achieved by performance based contracts. When a strata meets the key specifications that qualify it to be considered for one of the above options, the following additional factors are also assessed before a decision is made.

- Control history including the control methods that have been used, any evidence of aversion to these methods and any difficulties in achieving specifications
- The spatial and temporal distribution of all monitoring lines and line captures
- All wild animal and herd testing data including DNA strain type information from local infected herds and Tb wild animals
- An estimate of the time that the local wild animal population has been infected
- Consideration of the wild animal species that have been infected in relation to the potential timeframe for disease persistence
- Specific habitat features including the occurrence of any habitat disturbance such as clear felling of plantations
- The status of contiguous strata

Once Tb is believed to have been eradicated from wild animals within an area, based on herd testing and wild animal survey data, the final activities that are undertaken prior to ceasing vector control are designed to provide a quantified estimate of the probability of Tb freedom. When areas achieve 3 years of freedom from Tb vector associated herd infections and Tb infected vectors, then wild animal surveillance activities are intensified to provide additional surety, over and above that provided by livestock surveillance, of disease freedom in the wild animal population. With a low prevalence of infection in wild animals, disease is transmitted to stock very rarely, if at all. The sensitivity of herd testing as an indicator of wild animal infection is then low and influenced by stock density, which is also often low. In addition there is a lag phase of at least 3 to 12 months between domestic stock infection and detection. When the prevalence of infection in wild animals is low, wild animal sentinels are a more reliable and timely indicator of the presence of wild animal infection compared with stock testing. However, low density populations rarely provide sufficient data from just one sampling episode to make definitive decisions. Increased sensitivity is obtained by building datasets over time, using repeat and systematic surveys that are geographically spread over all risk areas. Sensitivity of disease detection can also be increased by submitting pooled lymph nodes for culture, including those from all target animals with no visible signs of Tb. Combining confidences determined from domestic herd surveillance and wild animal surveys provides the basis for deciding when it is safe to stop vector control. The permanent eradication of Tb from possum populations will not be assured until the disease has disappeared from all other sympatric wild animal populations. Ferrets are known to have a very short life expectancy and should present no long term problems. However, wild deer are believed to get infected from Tb possums and the reverse is also true. Given that the lifespan of a wild deer could be in excess of 10 years, an ongoing risk will exist until after these animals die. It is considered that the risk of Tb transfer from deer to possums is low but when the historical pattern of Tb spread throughout New Zealand is considered, the transfer of disease from live domestic deer to possums is a likely scenario in a number of cases. Any infected deer will continue to be a risk until their carcasses have decomposed sufficiently to ensure that any residual *M. bovis* bacteria are not viable. Wild pigs pose no risk of infecting possums or other species whilst alive. However, once dead they present a similar risk as wild deer carcasses. It is essential that periodic surveys continue for many years, especially in known previous high risk areas that support resident wild deer and pig populations. Domestic stock densities in such areas are usually low and cannot be relied upon to provide a timely indication that disease is present in the sympatric wild animal population.

The ability to get infected herd numbers down to low levels by way of having a comprehensive herd testing policy, applying risk-based movement controls on stock and implementing an intensive possum control programme, has been proven. There is no gold standard or definitive set of rules for deciding when it is safe to stop vector control. The need for quality datasets is vital to mitigate risk and assist in identifying critical knowledge gaps. The AHB needs to make decisions. Sometimes these decisions will be wrong but provided quality data is available, together with skilled disease and vector managers to analyse and interpret this data, then the likelihood of incorrect decisions being made is reduced and the probability of "getting it right most of the time" will be higher. The consequences of incorrect decisions will eventually be detected when herds are diagnosed as infected or when Tb is diagnosed in wild animal populations in the area of interest. How long it will take to detect failures depends on the intensity of surveillance. The NPMS is a finite Tb strategy with substantial but not unlimited resources. The potential cost of wrong decisions needs to be compared with the cost of expending financial resources unnecessarily, resulting in lost opportunity for other areas. Resources need to be redistributed between the regions of New Zealand over the life of the Tb strategy if the objective of Tb freedom by 2013 is to be achieved. Provided the key assumptions that the NPMS are based on are correct, namely that Tb will die out of possum populations that are sustained at low and even densities, and that ferrets and wild deer are not maintenance hosts (at least in most areas), and that the potential lifespan of the Tb vectors is taken into account, then the prospects for achieving Tb eradication in Southland are good.

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