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Taking an Endemically Infected Bovine Tb Area Through to Livestock Clearance. A Case Study of West Taupo, New Zealand

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TAKING AN ENDEMICALLY INFECTED BOVINE TB AREA THROUGH TO LIVESTOCK CLEARANCE. A CASE STUDY OF WEST TAUPO, NEW ZEALAND.

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Abstract: The Pest Management Strategy for Bovine Tuberculosis (Tb) in New Zealand aims to achieve efficient freedom from Tb by 2013 and to eradicate the disease from livestock and wildlife. The West Taupo area, in the central North Island of New Zealand, was chronically infected with Tb in both domestic livestock herds (cattle and deer) and within wildlife populations (brushtail possum, ferret, feral deer and pigs). Through the development and implementation of a technically innovative management plan, this area is now approaching Tb free status. The case study / management plan reported here discusses the operational techniques and strategies that were implemented to achieve Tb clearance in the livestock herds and the possibilities of eradication from wildlife species. It particularly identifies the variations in control strategies that are required as population densities reduce and the challenges of maintaining strong effective control at low densities of some wildlife species, whilst not needing to control other species that were initially clinically diagnosed with Tb control. Use of diagnostic tools and education as an area moves through the cycle towards Tb freedom are as essential as the physical control activities. The use of intensive monitoring of both livestock and wildlife species as trend and performance indicators and the need to educate farmers, hunters and other land use groups become increasingly important.

Key words: Bovine tuberculosis, eradication, management, monitoring, surveying, Tb, vector control

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INTRODUCTION

New Zealand is a group of islands in the South Pacific, covering some 269,000 km^2 (166,400 mi^2). There are two main islands, with a number of smaller islands surrounding them. It is the closest country to the South Pole, but with its long narrow shape contains many different climates.

In the 18th Century, Europeans began settling the country, which had previously been the domain of native tribes – the Maori. This colonization brought with it dramatic changes to the landscape. The good climate and fertile soils meant the land was well suited to intensive livestock farming techniques.

Most of the early settlers were English and they set about creating a "piece of England" in New Zealand. As part of this settling in process, they introduced a large number of exotic plant and animal species – principally sheep and cattle. However, a proportion of these cattle were carrying *Mycobacterium bovis*, the causative agent of bovine tuberculosis (Tb).

INTRODUCED SPECIES

Before human settlement, New Zealand had no mammals. The ecosystem had evolved to be an avian empire. Some bird species, the kiwi for example, were become flightless. Native plants evolved

into highly palatable food sources that attracted birds. These plants had no need to develop defences against the newly introduced mammals – no thorns or built-in toxins.

In the late 1800s, with the approval of the New Zealand government, a number of animal species were introduced. Deer were released into the wild to provide recreational hunting. Rabbits, goats and pigs were brought in as food sources. The brushtail possum (*Trichosurus vulpecula*) was introduced from Australia for its fur.

Rabbits quickly became a pest to the farmers and as a result shortly afterwards mustelids (ferrets, stoats and weasels) were introduced to help reduce the rabbit population. Without any natural predators, the introduced species thrived, and by the 1930s they had become major conservation pests. The toll on New Zealand's native flora and fauna was immense with a number of species becoming extinct and others becoming highly endangered. It was identified that the brushtail possum was the biggest culprit in this environmental damage and while attempts were made to reverse the effects, they were not successful.

POSSUM AS VECTORS

In the 1940s, people started to question why there was an ongoing level of tuberculosis in the human population. While the proportion of people contracting the disease had not changed particularly, the level of interest in reducing it had increased. Un-pasteurized milk was a leading agent in humans developing tuberculosis. This was because the cattle herds in New Zealand were now carrying a high level of bovine Tb, developed over the years from the infected stock originally introduced. Pasteurization of milk became standard and the levels of tuberculosis in humans declined dramatically.

At the same time, they set about reducing the levels of bovine Tb in livestock. A compulsory Tb livestock-testing program was developed. Most of the problem was reduced, by identifying Tb infection in livestock and requiring a compulsory slaughter of any cattle that had a reactor. However, in some parts of the country the testing kept showing more and more cattle with positive Tb reactors – chronic levels of infection.

During this period international trade standards were developed. The standard defined 'Tb freedom' as less than 0.2 percent of herds in any country carrying bovine Tb. Any country that did not meet this standard was required to demonstrate a commitment to reducing the incidence of Tb or risk trade barriers being imposed.

New Zealand's agricultural base, meat and dairy exports, were (and still are) the backbone of the economy. Despite everything, the levels of bovine Tb continued to climb and this was causing a high level of concern.

In 1967, a Tb infected possum was discovered on the west coast of the South Island. This was the first indicator that feral animals were acting as vectors in transmitting disease to cattle. This was followed by further Tb-infected possum discoveries.

By 1972, it had been formally confirmed that brushtail possums were vectors in the transmission of bovine Tb. While other feral animals had been discovered with Tb, there was strong correlation between areas with Tb-infected possums and high levels of cattle reactors. The possum became public pest number one.

West Taupo, New Zealand

The case study I am discussing covers the West Taupo area.

If you look at a picture of the North Island of New Zealand the blue water mass in the middle is Lake Taupo. The lake was formed by a series of eruptions, over 1,800 years ago which blasted out about 60 cubic kilometers (38 cubic miles) of earth rock and mud, leaving a massive crater. South of the lake is Mount Ruapehu, New Zealand's largest active volcano.

The area to the west of Lake Taupo is where we are going to be focusing. It is bordered on one side by a large range of mountains covering over 83,000 hectares (200,000 acres) and on the other by Lake Taupo.

The land boundering the shores of Lake Taupo is not developed and provides a fringe of dense scrub and bush between developed farmland and the lake covering 6,000 hectares (15,000 acres.) There are a number of fenced off conservation areas that dissects the farmland and provides linking habitat between the mountain range and the lake edge.

The farmland lying between these two features covers an area of 23,000 hectares (57,000 acres) and includes a mixture of sheep, beef, dairy and deer farms.

CONTROL IN THE 1970s

Once the link between possums and Tb infection was discovered Tb vector control operations began. Locations of control were established where this link was verified by surveys which found Tb infected possums. The majority of areas had very high possum populations as there where no preditors and an abundance of food available.

Sodium monofluoroacetate or 1080 as it was commonly known was the main toxin used in New Zealand for pest control. New Zealand does not have any native mammals so there are not the same constrains of its use as in other countries. It is a cheap, easy to use, environmentally safe and effective toxin with the added advantage of targeting other non-desirable introduced species that were regarded as pests such as mustelids, rabbits, rats and mice.

This toxin was the main, and in a majority of areas, the only technique used in the early days. Control operations were one off and expected to reduce the population sufficiently to break the disease cycle.

The aim of the control programs was to reduce the population as low as possible, with a 75 percent kill considered sub standard and anything near 90 percent was considered a very good result. This being similar to the 80/20 rule, where the cost to reduce the population further would be proportionately greater, with no extra gains made in reducing the infection rate than what was already achieved.

There was no systematic follow up of these on-off operations and annual Tb testing of livestock indicated the infection rate reduced following these operations and annual testing was thought enough to keep the disease in check.

In West Taupo

The program in West Taupo followed a similar format. All habitat was targeted and each farm had a poisoning program undertaken using sodium monofluoroacetate (1080). This effect required close liaison and cooperation from farm managers and owners as livestock needed to be shifted and kept clear of paddocks during the poisoning program. Annual Tb testing continued with noticeable reductions in reactor numbers following these control operations.

CONTROL IN THE 1980s

The program during the early 1980s continued in a similar manner as to that practiced during the 1970s. As reactor numbers and herd incidence of Tb climbed, control operations were implemented. A

pattern emerged of control operations reducing reactor rates for a few years, which was followed by these rates rising. Ground control techniques applied were similar to those used in the 1970s. During this period there was a greater realization that the possums in adjoining areas of habitat were quickly migrating into previously treated farmland areas, and to a large degree nullifying the control that had been carried out.

To combat this there was an increasing practice of establishing a buffer of control along the fringes of bush areas. These buffers were treated by aerial application of 1080 baits using fixed wing aircraft and their width ranged from 150 to 1,500 meters. There was no navigational equipment in these aircraft and the pilots flew by sight. The quality of bait distribution depended on the flying skills of the pilot who relied on map reading, memory, compasses and altimeters for their navigated guidance. Because of this approach, coverage of areas with bait ranged between 55 and 80 percent, resulting in some areas not being treated, from which possums quickly reestablished themselves.

After five years of more intensive control it was thought Tb was in check and well on its way to being beaten. This coincided with other economic conditions existing at the time, which resulted in funding for Tb control being reduced significantly, causing a scaling down of possum control and reliance that cattle testing would manage the disease.

By the end of the 1980s it became apparent that this was not the case and any gains that had been made were lost and the number of infected herds were rapidly climbing and nearing their peak.

In West Taupo

Aerial control was used to establish buffers along the bush margins next to farmland.

The areas treated in this manner included all the native bush land of the Lakeshore Reserves between Lake Taupo and the farmland, and one and a half kilometer (one mile) strip along the edge of Hauhungaroa Mountain range and the larger connecting conservation gully systems that linked these two areas of habitat. This aerial control coincided with another round of intensive ground control undertaken on the adjoining farmland.

A continuous line of bait containers every 50 to 100 meters were set along the bush pasture margins. These containers were re-baited each year to target animals as they migrated from internal bush areas to this margin before shifting to the farmland areas.

THE 1990s

The late 1980s and early 1990s was a time of change in New Zealand. It was accepted that Tb was not under control and there was a realization that a concerted effort was needed to control the disease and comply with the international trade standard, therefore reducing the risk of trade barriers being imposed.

A new organization, the Animal Health Board, was created to deal specifically with the bovine Tb problem. The Animal Health Board developed a national strategy to eradicate bovine Tb, and timeframes were established that allowed a long term and consistent approach to be taken. More importantly the amount of funding was significantly increased to allow the strategy to be implemented.

Another aspect of the strategy was the need for greater stock management, movement of stock controls, and Tb testing regimes. These changes brought the problem into a sharper focus for farmers and

helped educate them on the seriousness of the problem and to understand that they would be economically better off if the disease was eradicated.

In West Taupo

The number of infected herds peaked at never to be repeated levels, 27 out of 36 herds. At a 75 percent infection rate West Taupo was a long way from official Tb freedom (0.2 percent).

WHAT CHANGED?

In effect the whole control landscape changed overnight. There was a greater sense of urgency and understanding that Tb eradication would not be easy. There was to be greater cohesion and a much more integrated approach driven by the Animal Health Board to deal with all aspects of the disease simultaneously. This included:

Farmers - education through better communication and tightening of rules governing stock movement.

Livestock testing - continued testing of cattle, and where in-herd problems existed an increase in testing use of comparative and blood tests to identify animals that may not react to the standard test and yet be carriers and spreaders of the disease.

Research - increasing research to gain a greater understanding of the disease and ways of eradicating it.

Vector control - programs were implemented over larger tracts of land where Tb was identified. This included trebling aerial control buffers that joined the farmland areas. Aerial control in these buffer areas where changed to a cyclic program, when possum numbers increased to a set level the areas where re-treated.

Ground control on the farmland was extended to cover geographic risk areas with control changing to ongoing annual maintenance programs enabling possum numbers to be maintained to low levels. Performance measures were created based on residual populations, not on reduction in the population.

West Taupo

Annual ground control programs were established targeting all the farms and habitat in the area. The techniques used previously revolved around poisoning programs with 1080. These new programs were expanded to include an increased range of toxins, and as animals became shy there was a greater use of leghold traps.

Cyclic aerial control was undertaken in 1994 and again in 2000 treating both the Lakeshore Reserve edge of Lake Taupo and a buffer of control into the Hauhungaroa Range.

At the time Epro realized the importance of extending the buffer of control further than the new standard, which would keep animal numbers, lower for longer. Subsequently the buffer that was established in the Hauhungaroa Range extended for up to seven kilometers (4.5 miles) and included all the land that drained into the western side of Lake Taupo. These aerial control programs were carried out by helicopters using global positioning systems (GPS) which significantly improved bait coverage and increased the percent kill rate significantly. These efforts were rewarded in 1996 by a dramatic drop in infected herds from 26 to 16, and then 12 the following year, and again in 2001 when reactors went from 11 to four (Figure 1).

These activities were relatively successful and resulted in a significant reduction in infected herd rates which coincided with the aerial control. It was apparent that more was needed.

Updated modeling showed that possum numbers needed to be held to lower levels for longer than first thought. To achieve this, performance measures were

made stricter. Ferrets had come into the spotlight as potential vectors and spreaders of the disease and so control now focused on both possums and ferrets. Conversely it was found that feral deer, although carriers of the disease, were not transmitters. Pigs where found to be a very good indicator species, as they readily contracted the disease, but are an end host and do not transmit the disease.

As herd incidence of Tb had been severely reduced there was a need to know what was going on in the area. Was the disease present in wildlife, especially on farms that were now Tb free?

The use of indicator species took on a new role and control was supplemented with surveys. By 2000 the emphasis on surveys was high, in particular the autopsy and culture of suspect possums and ferrets that were caught. This was supplemented with the capture and autopsy of feral pigs associated with the area.

TREND IN WEST TAUPO

Since then the number of infected herds has continued to decline and the latest data indicates that there is only one infected herd left in the West Taupo area. The infection rate that was 75 percent in the late 1980s is now below two percent. You can see by this table, the divergence of the two lines, total herds and infected herds

What we learned in West Taupo was:

Annual ground control maintenance programs on their own only reduced reactor numbers until possums were at levels where the disease could not be maintained.

Cyclic aerial control produced significant results in reducing infected herd numbers.

The Hauhungaroa Range continues to be a point of re-infection.

An integrated strategy was needed, in addition to vector control that included increased disease cattle testing and increased farmer education. Increased surveys and diagnostic information is needed for quick response to treat potential problem areas.

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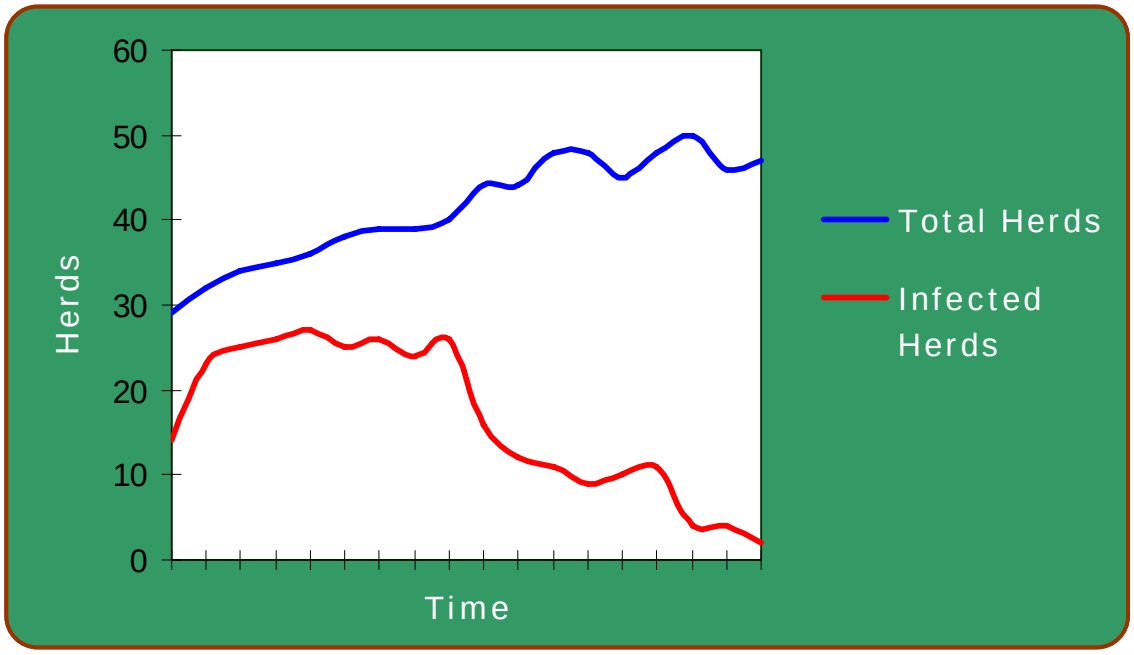
Table 1. Trend in West Taupo.



Looking Forward

What we have learned is that eradication is achievable, we are close and we now have a far better idea of how to get there. To go forward it is advantageous to look at the past and refine what has worked and build on that. We have proven techniques, but in applying them to meet the next stage new strategies have been developed.

What is planned for West Taupo?

On the farmland possum levels will continue to be kept below levels required for the disease to maintain itself. In doing this the emphasis will change to using products that indicate animals' presence instead of systematic control, and will involve greater use of technology to map and record these areas. Identified areas will then be specifically targeted for control to be implemented and will concentrate on retaining the animals taken for survey and diagnostic information.

The biggest gains have been made in the past with cyclic aerial control. This has hindered the migration of possums on to the farmland from adjoining bush areas where Tb still exists.

The next cycle of aerial control is linking a number of individual, and separately timed operations, into one large operation. Possibly, this effort will be the largest single aerial poisoning operation in the world, encompassing the whole Hauhungaroa Range and covers over 83,000 hectares (200,000 acres).

In planning this operation Epro has looked to maximise possum number reduction by redefining the standard practice applied to aerial control operations. This will include the increase of pre-feeding bait applications, over lapping effective swath widths, and increasing the sowing rate targeted at the highest density of animals present in any one location. The aim is to achieve as close to a 100 percent kill as possible, which will enable numbers to be kept be low for a long enough period to break the Tb cycle.

Following this operation a one kilometer buffer from the farmland will be actively maintained to keep the farmland free from Tb vectors.

There will be a greater use of surveys both of possum density and Tb indicator species to gauge the success of the program. To identify specific localities where the disease persists for targeted control to be undertaken in the future.

New Zealand is a great place and will be even better when we achieve official Tb freedom. We are well on the way to doing that as the West Taupo experience shows.

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