

THE WAIPAWA ENDEMIC AREA

The Epidemiological Picture

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The Waipawa area

This paper reviews the pattern of tuberculosis in the Waipawa area over the last decade. The Waipawa area is situated in Central Hawke's Bay. The livestock industry in the area comprises cattle and deer and sheep. The cattle herds are predominantly beef dry stock herds (finishing farms) with a few valuable breeding herds. The deer herds were established in the early to mid 1980's at a time when the Tuberculosis (Tb) control programme was voluntary. Tb in the area during the 1980's was characteristically sporadic. Every two to three years a breakdown occurred. A breakdown is the infection of a previously clear herd. Normally the herds involved were dry stock herds and only singleton cases were detected. The area itself is mostly open farmland. The Waipawa river runs through the area in a braided river bed, which is lined by willow trees. The river runs underground in many places. The river bed is used for extra grazing when feed is in short supply.

An exception to the Tb pattern

In 1988 most deer herds in the area were participating in the voluntary Tb control programme. One herd situated on the Waipawa river bank joined the scheme in late 1988. It was in this herd that the first exception to the pattern of sporadic singleton cases occurred. The first whole herd test of 1936 deer revealed 80 standard test positive deer. Blood testing indicated that 44 were infected with Mycobacterium bovis. The reactors were killed and buried on the property. The herd had been formed in 1983 and in 1986 a further 1500 deer from the South Island were introduced. They had been sale tested prior to their arrival. Tuberculosis was discovered in these deer and their progeny.

This breakdown was the first in the area which involved large numbers of animals. The extent of the disease in the infected animals is not known as the animals were destroyed and buried on the property without postmortem.

Three years later in September 1991 another exception occurred on a cattle property not far from the deer herd. Inspection at slaughter detected five cattle with Tb lesions. They had been on the property for 5-14 months. The epidemiological investigation raised concerns. It appeared that the Tb had not been introduced to the herd with the movement of stock. Endemic tuberculosis was suspected at this point.

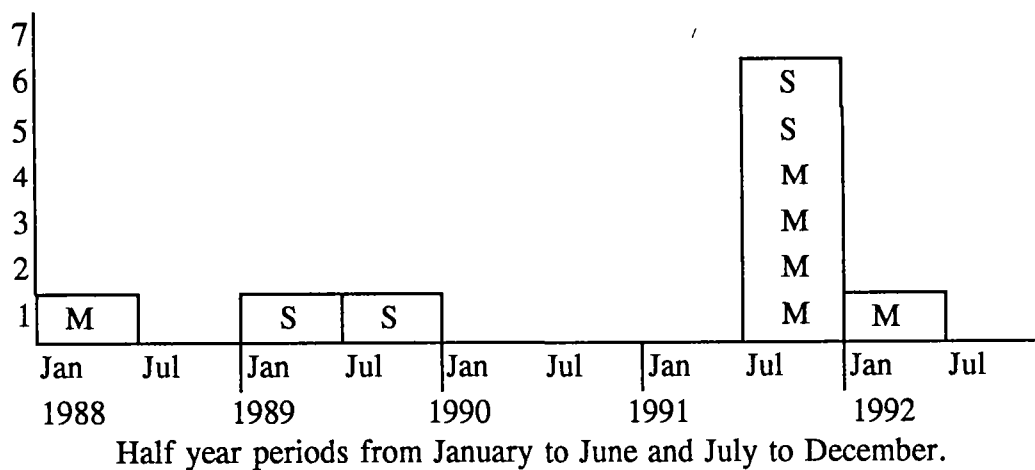
Clustering of Cases

Over the following few months a new phenomenon was observed in and around these two herds. The Waipawa area can reasonably expect to have 2 cases of Tb each year. The area contains 10% of the regions herds and each year the transport of stock into the region has accounted for 20 breakdowns of Tb. In the following six month period there were 8 breakdowns in the immediate area. Four of these breakdowns were consistent with the pattern of infection in the area. They were from beef dry stock herds and involved one animal only. The remaining four breakdowns occurred in an accredited deer herd, a beef breeding herd, and two dry stock herds. These breakdowns were characterised by the spread of the disease within the herds. The proximity of the breakdowns to the Deer herd which had the large breakdown in 1988 and the increase in the frequency of disease indicated that there was a new factor effecting the disease pattern in the area. Figure 1 shows the pattern of disease over time. Figure 2 shows a map of the area with the clustering of cases.

Figure 1 Shows the change in pattern of breakdowns over time and the development of multiple Tb cases within cattle and deer herds.

Number of Breakdowns M = Multiple cases of Tb in a herd
 S = Single cases of Tb in a herd

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Possum Surveys

The first signal that Tb might be present in the feral animal populations of the Waipawa area was the cattle property which broke down in September 1991. A survey of feral animals on this property was undertaken in March 1992 and two possums with Tb were found. Another property close to the river bank had broken down in December 1991. A possum survey on this property also revealed two with Tb. Both properties had Tb in a number of animals and had very good records of stock purchases and grazing patterns. The ability to narrow the probable transfer of infection down to a specific time and place contributed to the success of the survey. On the first property records indicated the stock had been infected in a relatively small area. Only thirty possums from this area were sampled. Three samples were submitted and two cultured Mycobacterium bovis.

On the 3rd of March 1992 Tb was discovered in two possums on the property close to the river bank. The property was on the Southern side of the river, but as the river flows underground at this point it is not a barrier to possum movements. A total of 144 possums were surveyed. Samples from eight possums were submitted and 2 cultured Mycobacterium bovis. The Tb infected possums came from a dense patch of gorse on the property. The Animal Health Board contributed to the clearing of this gorse as it provided excellent nesting sites for possums.

DNA analysis of the Mycobacterium bovis isolated from the outbreaks showed that the strain of Tb was a Mackenzie basin strain. This was consistent with the South Island origin of the 1500 hinds introduced from the South Island in 1986. Breakdowns caused by the movement of stock into the Waipawa area typically involve a North-Central strain of Tb. DNA analysis in an area such as the Waipawa is an invaluable tool. Our understanding of the Tb in such cases would be enhanced if DNA analysis was freely available.

Designing the control area

Having found Tb in possums it was necessary to establish a control operation which broke the cycle of the disease in the possums. The only method currently available is to reduce the possum community by 70 % and maintain it at 40% of pre-control levels for a minimum of five years. This should break the cycle of the disease and lead to its eradication in the possum community. Another important consideration is to prevent reinfection from infected livestock.

The size and shape of the area to be poisoned was determined in April by analyzing the cattle and deer testing data and the possum related data.

The herd testing data showed a cluster of herds with Tb cases adjacent to the Waipawa river. The herd testing data indicated that Tb was confined to a relatively small area. Testing data lags behind the spread of endemic tuberculosis and may reveal a smaller area than is actually affected. All herds in the area were placed on an annual test of all stock.

The possum community was studied to determine how far infected possums may have dispersed and to determine the probable size of the infected population. From dispersal studies by Brokie et al 1991 and other population information it was possible to estimate the number of infected possums leaving the immediate area as well as the probable distance they travelled. Obviously the size of the control area would have to cater for the spread of the disease with the movement of possums. There are four steps required to calculate the degree of spread.

1. The numerical size of the infected population.
2. The number of possums which have dispersed.
3. The number of Tb infected possums which have dispersed.
4. The distance they dispersed.

It was assumed that the possum population by the river first became infected between 1986 and 1988 from the 80 infected deer. The adult possum population was assumed to be very stable with only 25 % of juvenile males and 5 % of juvenile females migrating. The numbers of juveniles at any one time was assumed to be 18%. The population density of the possums

along the river was estimated at 5 per hectare. It was assumed that the possum population along the river between State Highway 50 and the Mangaonuku junction was infected with tuberculosis and that there had been a steady spread along the river over the last four years.

1. The size of the infected population over that period was calculated at 7000. The calculations are shown in Table 1.

Table 1 The number and range of the possum community in which Tb was cycling.

Year	Km Spread	Range in Hectares (Ha)	Possum density per Ha	The size of the possum community
1987	-	-	-	-
1988	2.4	96	5	480
1989	4.8	192	5	960
1990	7.2	296	5	1480
1991	9.6	384	5	1920
1992	-	470	5	2350
TOTAL		470		7190

2. The number of possums dispersing out of the infected area was calculated at 195. These calculations are shown in Table 2.

Table 2 The number of juvenile dispersals from the infected community.

Year	Total Population	Juvenile Female	Juvenile Male	Migrating Female	Migrating Male	Total Migrating
1988	480	43	43	2	11	13
1989	960	86	86	4	22	26
1990	1480	133	133	7	33	40
1991	1920	173	173	9	43	52
1992	2350	212	212	11	53	64
TOTAL	7190	647	647	33	162	195

3. The number of Tb infected possums dispersing is calculated by multiplying the number dispersing by the prevalence of disease. This was obtained from the possum survey. It can be estimated that of the 195 possums dispersing 3 were infected with Tb.
4. To determine how far the possums dispersed we have adapted Bob Brokie's data on possum dispersal over farm land. Figure 3 shows juvenile dispersal data on farm land dispersal at Bridge Pa and from other farm land. Bridge Pa is only 70 Km from Waipawa and has a similar geography and possum habitat to that at Waipawa. A total of 48 dispersals were recorded. The distance dispersed by 80 % of these possums was less than 7 kilometres. The mean distance being 5 km. Ninety-five percent of the possums studied did not travel further than 11 km. On this basis possum control was undertaken in a 7 kilometre radius of the riverbank. The testing of herds within a 11 km radius is undertaken annually.

Figure 2 **Map of the Waipawa area showing the cluster of herd breakdowns**

- Location of deer herd with a large outbreak in 1988. Thought to be the source of infection for the possum community.
- Location of surrounding herds which have had breakdowns.
- Riverbed
- Herds with multiple cases of TB.

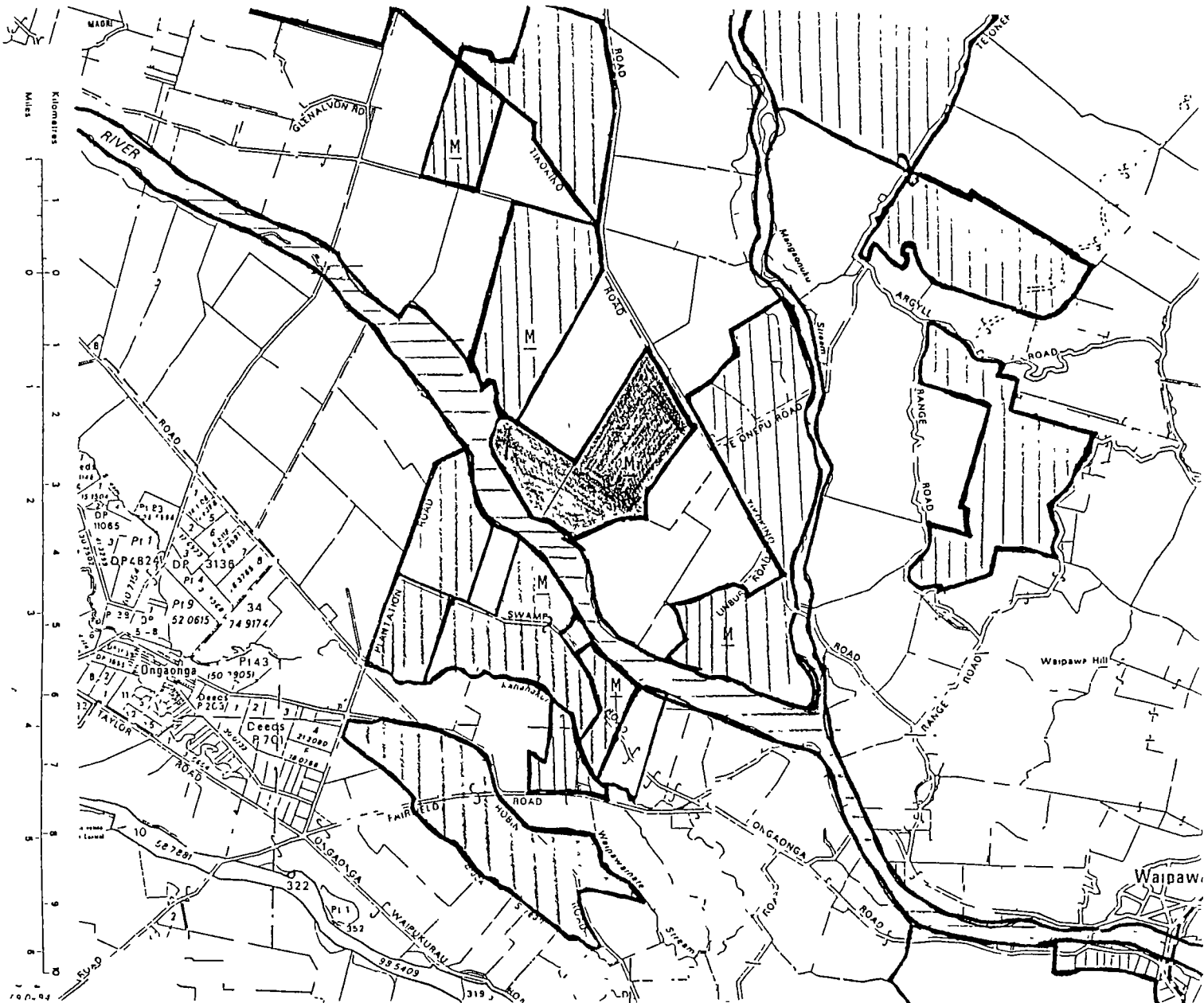
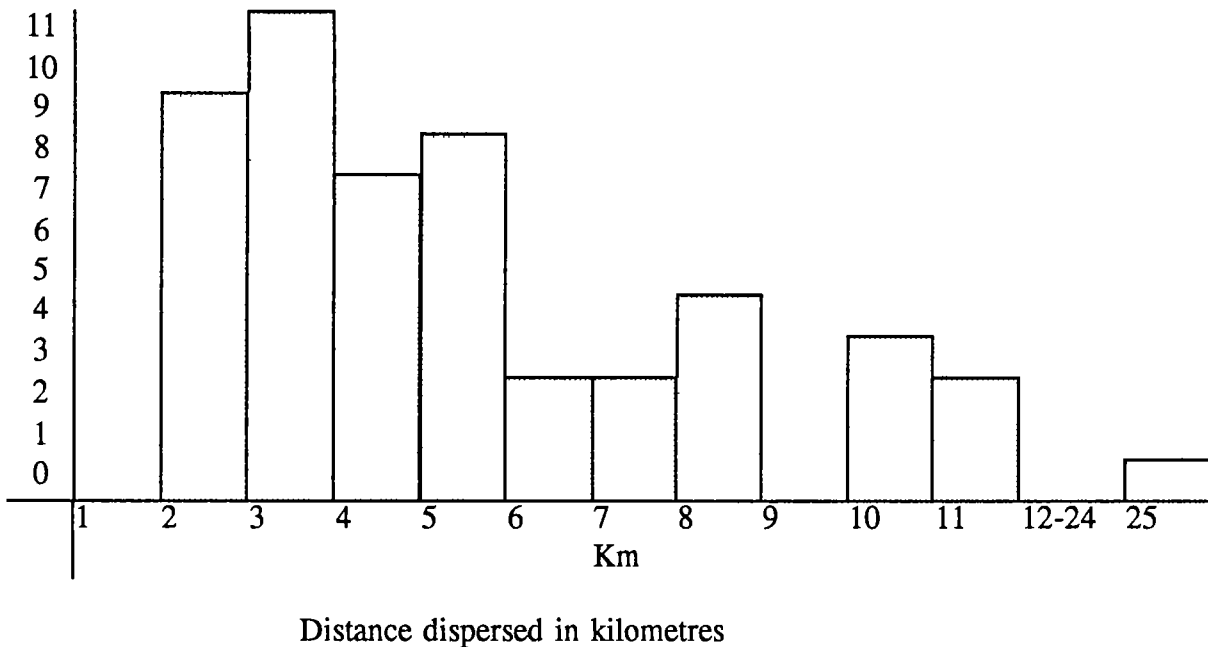


Figure 3 Graph of the distance in kilometres that juvenile possums dispersed over farmland.

Number of Dispersals.



Possum Control

The possum control operation commenced in May 1992. Poison was applied over an area of 26500 hectares. The operation was monitored independently by MAF and the Regional Council. The percentage reduction was estimated by these authorities at 87% and 92% respectively. The cooperation of the farming community contributed to the success of the operation.

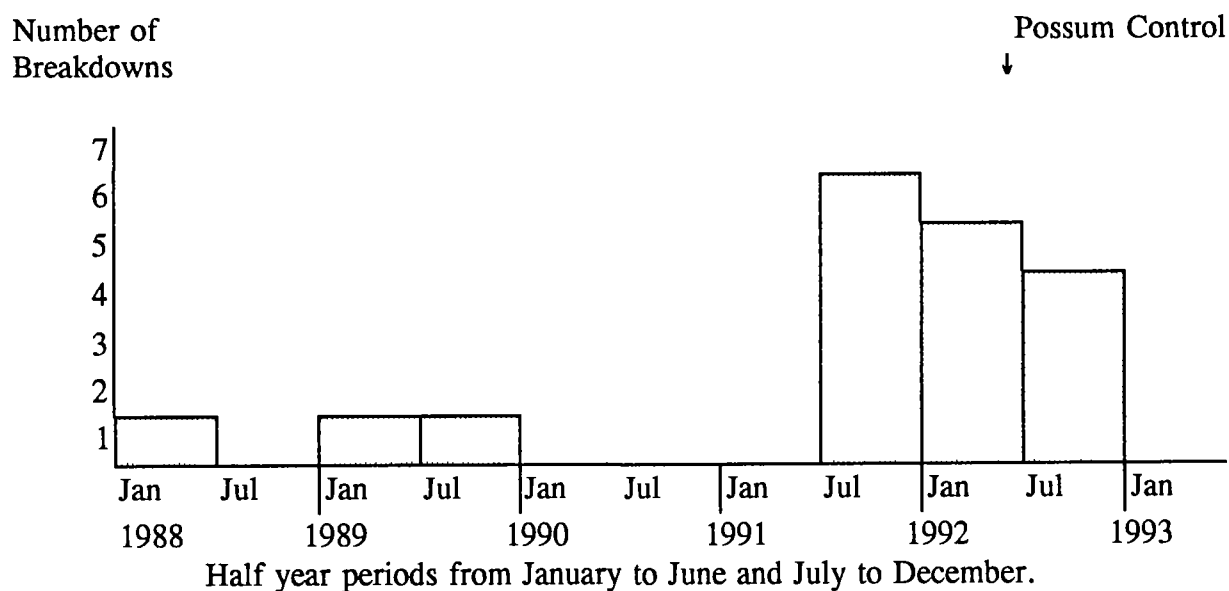
The effectiveness of the poison operation

Since the definition of the endemic area and the implementation of possum controls a reduction in the number of new cases of Tb has been observed. Since the possum control operation there have been no breakdowns caused by infected possums. Two breakdowns have occurred which resemble the pattern of disease in the district prior to 1988. The breakdowns were in dry stock herds and only involved single animals. Of the 236 herds in the area 4 are on Movement Control. This amounts to 1.7% of all herds. The percentage of herds on control in the wider Hawke's Bay region is 1.2% of all herds.

A considerable amount of testing has been undertaken. Since January 1992, 38,000 cattle and 20,000 deer in the control area have been tested. A total of 36 tuberculous animals have been found. By July 1993 there were only four herds with a herd status of 'Movement Control'. Three of the four have had clear herd tests. The fourth herd is still infected. The source of infection is considered to be infected possums on the Waipawa riverbank. The time

of initial infection has been narrowed down to May 1992 (at the time of the possum control operation). Figure 4 shows the reduction in new Tb breakdowns and the commencement of the possum control operation.

Figure 4 Tb breakdowns over time and the commencement of possum control work.



Conclusion

A new pattern of Tuberculosis was detected in the Waipawa area. A clustering of cases was observed. There was also a change in the nature of breakdowns from single to multiple cases within herds. Tuberculosis was found in possums along the Waipawa River. DNA analysis confirmed that possums had become infected by a Mackenzie basin strain of Tb, which is thought to have been introduced to the area with the importation of deer from the South Island. DNA analysis is a powerful epidemiological tool. Following the breakdown of Tb in the deer herd up to 17 herds became infected within a 4 km radius. Since the possum control operation the number of new cases has dropped off and the disease pattern is returning to that of the mid 1980's. There are now only four herds in the area on movement control. There is no evidence of feral animals transmitting the disease to livestock after the initial control operation.

References

- Brokie R.E et al. 1991. Recolonisation and dispersal of possums on Hawke's Bay farmland 1988-1991: A progress report. DSIR Land resources Technical Record 51.