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**Factors influencing the epidemiology  
of *Rabbit haemorrhagic disease virus*  
in New Zealand**

**A thesis presented  
in partial fulfilment of the requirements  
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## Abstract

The European rabbit (*Oryctolagus cuniculus*) is a major pest species in New Zealand. The illegal introduction of *Rabbit haemorrhagic disease virus* (RHDV) in 1997, for purposes of biological control of pest rabbit populations, was a controversial event due to uncertainties about the impact of the disease on both rabbit populations and other potential host species. This thesis presents a series of studies conducted to investigate several aspects of the epidemiology and biology of RHDV in New Zealand, and to assess the opinions of farmers about the usefulness of RHDV for rabbit control.

A longitudinal study was conducted in an area of low rabbit density near Himatangi in the lower North Island of New Zealand. Rabbits were trapped at weekly intervals over 37 months using a capture-mark-recapture approach. The study was initiated shortly after the first rabbit haemorrhagic disease (RHD) epidemic occurred in the area, and focused on evaluating the relationships between the occurrence of RHD and the dynamics of the rabbit population. Over the course of the study, predation, particularly by cats, was the principal cause of rabbit mortality. RHDV was present every year in the late summer-autumn period, but caused discernible outbreaks with high mortality only in the first and third years. Fluctuations in population immunity due to population turnover and influx of susceptible immigrants appeared to be key factors contributing to the intermittent occurrence of the disease. Infected migrant rabbits may also be a source of reintroduction of virus and new disease outbreaks. Rabbit deaths due to RHD were clustered in time and space, and RHD affected animals died closer to their home range centroid than rabbits dying of other causes.

In cats, ferrets, stoats and hedgehogs that were trapped at the site, seropositivity to RHDV was detected up to several months before and after RHDV infections in wild rabbits. These predatory and scavenging species may act as vectors causing localized spread of the disease. During the course of the study, the abundance of six fly species identified as potential RHD vectors was also determined. The influence of climatic factors on fly abundance varied between species, and peaks in fly abundance in late summer and autumn coincided with RHD outbreaks.

Two aspects of the survival of RHDV in the environment were investigated using experimental exposure of laboratory rabbits to determine viral infectivity. The survival of RHDV on two matrices (liver and cotton) exposed to environmental conditions on open pasture was evaluated. RHDV in bovine liver tissue, used to emulate a rabbit carcass, remained infective for up to three months under field environmental conditions. RHDV on cotton, which was used to emulate excreted RHDV on an inanimate substrate, remained infective for less than half that time. These observations suggest that RHDV in decomposing rabbit carcasses could be a relatively persistent reservoir of the virus. RHDV that was inactivated with UV-light failed to induce protective immunity in rabbits following oral or parenteral injection, indicating that inactivated virus on baits is unlikely to induce protective immunity in wild rabbits and thereby jeopardise the effectiveness of RHDV use.

Using a multistage sampling frame, the attitudes and practices of farmers regarding rabbit control, and particularly RHDV, were evaluated using a mail questionnaire. Shooting remains the predominant method that farmers use to control rabbits, although 10% of farmers used RHDV baiting. The use of poisoning and trapping for rabbit control has declined since the introduction of RHDV. Most farmers considered that the introduction of RHDV has been beneficial.

The impact of RHDV on rabbit populations appears to be highly variable. These studies have provided detailed documentation on the occurrence of RHDV and its relationship to rabbit population dynamics in an area of low rabbit density. Overall, the findings suggest that both the expected benefits and the potential ecological risks from introducing RHD to New Zealand, were overstated. While the disease certainly had a marked impact on the population at Himatangi at certain times, outbreaks were intermittent and other 'natural' causes of mortality may exert greater constraints on rabbit populations. Better understanding of the factors that contribute to the variability in frequency and severity of RHD outbreaks may enable more efficient use of this method in the future. RHDV is likely to remain a useful option for rabbit control, particularly in areas of severe rabbit proneness, and will likely prove most effective when used in conjunction with other methods.

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