DETECTION OF NEW INSECTS AND DISEASES IN INDIGENOUS FORESTS IN NEW ZEALAND

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ABSTRACT

The prime objective of forest health surveillance, as defined in this paper, is the early detection of introduced insects and pathogens in order to minimise damage, enhance the possibility of eradication, and limit the cost of control. Since the introduction of systematic surveillance in New Zealand the emphasis has been on protecting plantation forests and little has been done in indigenous forests. The Department of Conservation has not yet taken steps to address this apparent imbalance.

The cost of a comprehensive surveillance programme for New Zealand's indigenous forests is estimated at \$4.5 million, compared with current costs of \$2.4 million for control of fire, \$2.3 million for weeds, and \$5.8 million for wild animals. There are differences between plantation and protected indigenous forests which might influence susceptibility to, or seriousness of, introduced insects or pathogens, and various factors will need to be considered in developing a forest health surveillance strategy.

Keywords: forest health surveillance; disease detection; introduced insects; indigenous forests

INTRODUCTION

A prime objective of conservation management of indigenous forests in New Zealand is to minimise the impacts of man and agents introduced by man on forest health. Ill-health of forests can be caused by wild animals, climatic or environmental changes, native insects and pathogens, introduced insects and pathogens that are well established, and newly introduced insects and pathogens. Fire and introduced weeds also damage forests but the symptoms they produce are quite distinct from those of agents listed above.

Techniques for monitoring long-term trends in forest health and condition have been developed by the Forest Research Institute and there are many permanent vegetation assessment plots throughout the indigenous forest estate. Generally, the Department of Conservation will not intervene when ill-health results from natural causes. Exceptions would be when water and soil values are threatened, when dieback is of a catastrophic nature, or when rare flora or fauna are threatened.

Similar symptoms of ill health can result from a variety of causes and detailed investigations may be required to determine the primary cause of ill-health found during surveillance. However, there is a clear management distinction between problems caused by newly introduced insects and pathogens and those arising from other sources. The early discovery of newly introduced insects and pathogens can substantially reduce the cost of any remedial action.

This paper examines the justification for routine forest health surveillance in indigenous forests for the specific purpose of discovering newly introduced insects and pathogens. For the purposes of this discussion, early detection is regarded as the prime objective of a forest health surveillance system.

PAST AND CURRENT LEVELS OF SURVEILLANCE IN INDIGENOUS FORESTS

A survey to detect disease or ill-health is conducted at least annually in most plantation forests in New Zealand. Historically our indigenous forests have received only cursory attention in respect of detecting the presence of introduced pathogens and insects. The New Zealand Forest Service assigned about 5% of its forest health surveillance effort towards indigenous forests, despite the fact that they occupy some six times the area of the plantation forests. This imbalance may have arisen because indigenous forests have traditionally been thought of as being of lower value than plantation forests. To some extent this attitude may still exist. For example, an article on cabbage tree dieback in the New Zealand Herald on 15 April 1989 included the comment "because the cabbage tree was not a commercial crop it had not been given top priority". On the other hand, the imbalance in allocation of surveillance resources may reflect the perceived difference in risk between exotic and indigenous forests. Or it may reflect difficulties seen in significantly reducing the risk from new introductions at a reasonable cost.

To date the Department of Conservation has made no significant move to redress this apparent imbalance. An obvious reason for this is the difficulty in determining a satisfactory level of surveillance. Because there has been little effort in the past to detect insects and pathogens entering indigenous forest, there is no analytical basis for risk analysis or for determining an appropriate level of surveillance. A second impediment is the high cost, in relation to the total budget for all forest protection functions, for a level of surveillance similar to that currently carried out in plantation forests.

WHAT IS THE APPROPRIATE LEVEL OF SURVEILLANCE IN INDIGENOUS FORESTS?

Because a suitable level of surveillance cannot be established from risk analysis, an alternative is to use "the willingness to pay" of managers of plantation forests as a guide to the appropriate level of spending in indigenous forests, and to compare this with expenditure by the Department of Conservation on controlling other threats to indigenous forests.

Plantation managers consider it reasonable to spend about $1/ha/annum on forest health surveillance. Using this as a guide, surveillance spending in indigenous forests would be of the order of $4.5 million. However, access difficulties due to lack of roading, the floristic complexity of indigenous forests, and a lower level of experience in detecting indigenous forest disorders, mean a greater sum per hectare would be required to achieve a similar probability of detection of new introductions.

The other major protection functions of the Department of Conservation are wild animal control, fire control, weed control, and, less directly, inventory and monitoring of estate condition. Inventory and monitoring contribute to forest health surveillance but generally do not contribute to early detection of new insects and disease. In 1988–89 the Department spent $2.4 million on fire control, $5.8 million on wild animal control, $2.3 million on weed control, and some $0.2 million on inventory and monitoring.

In the 1988–89 year fire damaged about 9000 ha of the conservation estate. The effects of wild animals can be seen in the selective browsing of plant species. This tends to have an insidious impact detectable only over decades in which vegetation composition is altered and native animal carrying capacity reduced. Problem weeds change the basic characteristics of the estate by usurping the existing vegetation cover or impeding its regeneration. Priority is given to controlling these weeds. Weed control is also done to comply with the Noxious Plants Act which is generally directed at protecting adjoining agricultural land rather than conservation values. Inventory and monitoring of protected areas provides management information essential to safeguard the viability of protected areas against threats, especially from plant and animal pests. This function currently has a low level of funding, because it has less urgency than many of the Department's other commitments.

Funding constraints mean the Department cannot achieve all that is desirable in the management of problem plants and animals. The effects of fire, weeds, and wild animals on forest health are well-known and on-going problems. The transfer of large sums from these activities to forest health surveillance is not regarded as providing an improvement in total estate protection. The lack of risk analysis, and of information on the likely success of an indigenous surveillance strategy, have contributed to this view.

The Department of Conservation is responsible not only for indigenous forests, but also for other ecosystems such as wetlands and grasslands which may be more fragile than forests and are certainly less represented in the protected areas network. Protection of the health of these ecosytems must also be considered along with the protection of forests.

RELATIVE RISK TO PLANTATION AND INDIGENOUS FORESTS

Biological and management differences between plantation and indigenous forests that might influence susceptibility to introduced pathogen and insect pests, seriousness of introduction, and effectiveness of forest health surveillance, must be considered.

Indigenous forests are not a monoculture whereas New Zealand's exotic forests generally are. Although *Nothofagus* spp. dominate large areas of New Zealand's indigenous forest, most show considerable floristic diversity. Plantation tree breeding programmes in New Zealand have been designed to maintain tree-to-tree genetic diversity. Reviews by Bain (1981) and Chou (1981) indicated that, provided tree-to-tree genetic diversity is maintained, there is little evidence to support the hypothesis that monocultures are more disease-prone than mixed forests.

There is no history of host and introduced disease co-evolution for native tree species. This contrasts with New Zealand's exotic plantation species where there is a pool of diseases known to cause damage in their country of origin. Chou (1981) pointed out that indigenous forests may be defenceless against foreign diseases because co-evolution has not occurred and provided a degree of disease resistance.

Nurseries raising plantation species are often located within plantation forests. There is a chance that disease or insects may spread to seedlings and be transported around the country when seedlings are distributed. However, there is less bulk transportation of indigenous seedlings around the country and a lower risk of diseases or insects spreading from mature trees to seedlings because nurseries raising indigenous trees are not generally situated within or near indigenous forests.

Wild animals and weeds have a greater impact on indigenous forests than on plantation forests. The Department of Conservation places higher priority on controlling these than on surveillance to detect newly introduced insects and pathogens.

An aerial survey focusing on canopy and emergent trees, is suitable for plantation forests where the crop trees are visible from the air. In indigenous forests, plants other than the canopy trees are also of value. Lack of road access to indigenous forest means surveillance to detect those diseases not evident from the air is considerably more expensive.

There are few examples of diseases which have completely eliminated a plant species. Bain (1981) stated "It is far more likely that a new pest would, at worst, kill over mature or unthrifty trees and/or cause loss of increment". Loss of growth rate, loss of stand volume from scattered loss of mature trees, or loss of form are, in themselves, of little concern in indigenous forests.

In indigenous forests even dramatic health problems may be of little long-term significance. The regeneration that replaces the original damaged vegetation cover may have many of the values of the original cover. However, dramatic changes in species composition would be of concern. By contrast, regeneration after catastrophic dieback in plantation forests would be inferior to planted stock in terms of tree spacing, stocking, and genetic quality.

Indigenous forests are left more or less undisturbed by management practices. Whether this enhances disease resistance is not determined. However, it certainly increases the cost of surveillance.

The lack of anything equivalent to the detection and control of Dothistroma in plantation forests may make managers of indigenous forests complacent.

Because of land-clearing patterns, indigenous forests are often in axial ranges far from high risk areas such as ports.

In summary, there is no compelling evidence to indicate that the risk to the indigenous forests from introduced insects and pathogens is lower than the risk to plantation forests. However, because "natural" disease processes are not viewed as being necessarily detrimental to indigenous forests, because wood quality is not generally of importance in indigenous forests, and because regeneration after dieback may be a near-perfect substitute for the original crop, it is possible to advance the argument that the values of indigenous forests are less at risk from insects and diseases than those of plantation forests. It is also apparent that the effectiveness of each dollar spent on surveillance to detect new introductions is lower in indigenous forests than in plantation forests.

OPTIONS FOR INDIGENOUS FOREST HEALTH SURVEILLANCE

The level of risk to indigenous forests from introduced pathogens and insects is largely unknown. Even less is known about the reduction in risk that would result from various levels of surveillance. Forest health protection in indigenous forest seems to require a different approach from that used for plantation forests. One component of this, permanent assessment plots, is already in place. The options available to managers are to do no additional surveillance, do limited additional surveillance in high risk areas, or do comprehensive surveillance.

Current budget constraints and competition for funding from other protection activities dictate that only a sample of the protected estate be surveyed to detect new introductions. It would seem wise to spend limited resources searching very high risk areas, even if introductions are infrequent, because the potential loss of forest condition is very high and because the probabilty of detecting a new disease or insect is relatively high at its likely points of entry. Some level of forest health surveillance is therefore justifiable.

The sampling strategy should be focused on port areas and industrial sites where imported forest materials are used. It is important to detect pathogens and insects before they become established away from these areas where the chances of detection are diminished. It may be desirable to undertake surveys of some large indigenous forest tracts situated in close proximity to international ports.

It is unlikely any system of random ground sampling to detect new introductions will ever be conducted in indigenous forests. There will always, therefore, be an upper limit on the probability of detecting new introductions which will be lower than the level in plantation forests. It must be hoped that the natural resilience and the ability of our indigenous forests to recover from ill-health are sufficient to ensure that they persist in the face of almost certain exposure to new introductions of insects and pathogens.

An analysis of the risk posed to indigenous forest by insects and disease and a review of the tools available to detect their entry and establishment are necessary before managers can select the appropriate management option. Any system must utilise existing resources such as permanent vegetation assessment plots.

CONCLUSION

The Department of Conservation sees forest health surveillance as providing an opportunity to eradicate new introductions and avoid serious damage to forests, or to reduce the cost of controlling new introductions and limit damage. Because of the cost-effectiveness of surveys of very high risk areas and the high cost of surveillance of the entire conservation estate, a limited surveillance option is favoured. It is more difficult and expensive to detect new introductions in indigenous forests than in plantation forests. Efforts must therefore concentrate on detecting pathogens and insects before they become established in remote areas. Expenditure on control of existing agents causing damage to indigenous forests, such as animal and plant pests, is generally regarded as being of higher priority than expenditure on forest health surveillance. A risk analysis and a strategy to minimise this risk should be developed.

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