volve preparation gaps with contingency species, and the current exclusion of improved, commercially deployed stocks from the scheme of long-term genetic management. The present commercial and institutional environments create some strong disincentives for forest managers to address these gaps or to have them addressed, but the gaps will not disappear spontaneously. In addition, an explicit risk-spread code is needed for field deployment practice. New biotechnology, like most new technologies, is at once both a tool for addressing risks and a source of new risks. The new risks pose challenges, but should be manageable if duly recognised.

Finally, the genetic aspects must be considered in the total context of risks. Trying to reduce genetic risks to zero may be futile if there are appreciable geophysical risks, e.g. of large pumice eruptions. The latter risks, however, will argue for a geographic risk spread in location of genetic material.

Acknowledgments

I thank Julia Charity, Luis Gea, Keith Jayawickrama, Paul McFarlane and Gerry Vincent for scrutinising a draft, in whole or in part.

References

Burdon, R.D. 1982. Monocultures - How vulnerable? New Zealand Forest Service, Forest Research Institute, What's New in Forest Research 115.

Burdon, R.D. 1992. Genetic survey of *Pinus radiata*. 9: General discussion and implications for genetic management. New Zealand Journal of Forestry Science. 22: 274-298.

Burdon, R.D. 1997. Genetic diversity for the future: Conservation or creation and capture? In, IUFRO '97 Genetics of Radiata Pine. New Zealand Forest Research Institute, FRI Bulletin 203. Pages 237-246.

Burdon, R.D. (in press). Risk management issues for genetically-engineered forest trees. New Zealand Journal of Forestry Science.

Burdon, R.D. and Miller, J.T. 1995. Alternative species revisited: Categorisation and issues for strategy and research. New Zealand Forestry 40(2): 4-9.

Grant, R.K. 1976. Impact of uncertain end-use on wood costs and its implications for forest planning. New Zealand Journal of Forestry 21: 58-67.

Jayawickrama, K.J.S and Carson, M.J. (in MS). A breeding strategy for the New Zealand Radiata Pine Breeding Cooperative. [Submitted to] Silvae Gentica.

Roberds, J.H. and Bishir, J.W. 1997. Risk analysis in clonal forestry. Canadian Journal of Forest Research 27: 425-432.

Storer, A.J., Gordon, T.R., Wood, D.L., and Bonello, P. 1997. Pitch canker disease of pines: Current and future impacts. Journal of Forestry 57: 21-26.

Sweet, G.B. and Burdon, R.D. 1983. The radiata pine monoculture: an examination of the ideologies. New Zealand Journal of Forestry 28: 325-6.

Forest biosecurity - getting it by the mothballs

Gordon Hosking

Abstract

An effective forest biosecurity strategy is fundamental to the future health of our exotic, indigenous, and urban forests. Such a strategy must be pathway focused, integrated across off-shore, border and post border components, and supported by strong data collection and scientific skills. The consequences of failure are severe, and the risks clearly evident. These risks can be reduced by a coherent, proactive and responsive strategy which builds on the lessons learned from past experience. Such an initiative must involve a partnership between Government, the sector, and science organizations, be strongly led, and utilize the best possible skills and information.

Introduction

Forest biosecurity might be defined as as:

'Preserving and enhancing the health and vitality of our forests and trees through strategies which exclude, detect, and respond to, new pests and diseases.'

In the past year or two, forestry sector support for biosecurity has sharply declined. It does not feature as a high priority with senior managers, particularly if it costs money or disrupts business. Corporate preoccupation with difficult market conditions and declining profitability, combined with the demise of the Ministry of Forestry, has led to a lack of focus on biosecurity issues.

I hope by answering six simple questions I can convince those of you that need convincing, that the sector should be leading, not following, in forest biosecurity, because we can not afford the cost of failure, and because its our business at risk not some bureaucrats in Wellington.

The questions I will attempt to answer are:

- What is the scope of forest biosecurity?
- Why should we bother?
- What are the risks?
- What can we do?
- What have we learned?
- What do we need?

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What is the Scope of Forest Biosecurity?

'A forest biosecurity strategy must consider the nature and value of the resource, the origin and entry pathways of the threats, and the expertise and capability needed to respond.'

It embraces the threat and its home, its travel plans, and its potential new pastures. We should start with the new pastures since if nothing is at risk, we can pack up right here.

The Resource

Exotic plantations extend over 1.8 million ha and are worth perhaps 40 billion dollars. Add to this the value of associated processing and infrastructure. Indigenous forests cover about 6.5 million ha of New Zealand and their value is incalculable. They include a substantial part of the country's biodiversity, protect fragile ecosystems and support associated industries such as tourism. Our urban forests are an integral part of the public environment of parks, reserves and streets, as well as the private environment of gardens and shruberys.

A $100 billion asset at risk would be a conservative estimate. The question we must ask is what would we be prepared to pay to at least partially insure such an asset? Car insurance is typically 2% of the vehicle's value and would cost about 2 billion a year. House fire insurance is typically about 0.3% of value and would cost about 300 million a year. Forest biosecurity presently costs somewhere between $3 and $10 million a year depending on how you aportion the contribution from other sectors such as plants and animals.

The asset values are huge while present insurance for even partial cover is very small and very patchy.

The Pathways

It is within the pathways that exotic pests and diseases travel that barriers can be erected. This pathway/barrier relationship is the critical element of any biosecurity strategy. Barriers can be focused at three parts of the pathway, at source, at our border, and at the establishment site.

At source

- pathogens and pests enter the pathway at some point, e.g. Asian gypsy moth eggs on imported vehicles from Japan
- barriers can exclude or treat contamination at source
- barriers at source require strong and collaborative relationships with trading partners
- barriers at source offer best separation of risk from potential establishment sites

At our border

- historically the border has been the centre of biosecurity action. Everything crosses our border at some point either legally, illegally or passively
- the border is the site of greatest control, site of greatest knowledge, and site of greatest persuasion

At establishment site

- new pests and diseases reach the end of the pathway at some point and establish in their new environment
- barriers can be erected by controlling the pathway i.e. don't let high risk goods into favourable establishment areas without special treatment, however, such strategies can be disruptive and difficult to implement
- surveillance and monitoring can be undertaken to detect early and eradicate new establishments

Pathway knowledge and integrated barriers are the key to the successful exclusion of pests and diseases, but are highly dependant on the third critical component of a forest biosecurity strategy, intellectual capital.

The Intellectual Capital

The intellectual capital of forest biosecurity includes the skills and experience of operational and scientific staff, the data and information they have access to, and the international linkages and collaborations they maintain.

Expertise and experience

- ensures risk assessment for individual threats and pathways
- allows response strategy development
- provides response capability

Forest biosecurity must retain the big picture view, and apply prioritized and pragmatic strategies based on good intelligence, experience and sound science within a collaborative environment.

Why Should We Bother?

'The unpredictable consequences of biosecurity failure, which include financial loss, environmental damage, and ongoing control costs, can be greatly reduced by an effective strategy.'

The easy way out is to simply say 'it's all too difficult, the level of uncertainty is too high, and, the costs and benefits are impossible to quantify so lets just cross our fingers and be optimistic.'

We can do better than this, unquantifiable or not the benefits of success are readily identifiable in both financial and non-financial terms.

Financial rewards

- retained forest productivity, lower management costs, and greater management flexibility
- fewer constraints on trade and market access
- reduced costs and constraints to our urban forest environment
- healthier forests which enhance our tourism experience and image
- effective biosecurity strategies which say we are serious about our clean, green image

Quality of life

- healthy forests and trees make our living and recreational environment more attractive
- fewer pests and diseases ensures fewer controls including reduced use of chemicals

Biosecurity failure is unpredictable, with the impacts of new pests and diseases almost invariably wider than forestry e.g. horticulture, agriculture, public health. The exotic pest and disease risks crossing our border can be greaterly reduced, and incursions limited, with a well designed, integrated and supported, forest biosecurity strategy.

What are the Risks?

'The risks are numerous, varied, and unpredictable, but travel along identifiable pathways closely associated with people and goods crossing our border.'

We can show serious biosecurity risks to our forest estate clearly exist from our knowledge of the forests of our trading partners, from past experience at our border, and from the actual history of establishments in New Zealand.

What's out there

- plenty, including lymantriids, gall rusts, pitch cankers, bark beetles, tip moths
- we can pick some high risk groups but we can't pick individuals; e.g. why did white spotted tussock moth establish and not Asian gypsy moth, why *Arhopalus tristis* and not *Arhopalus rusticus*, why *Sirex noctilio* and not *Sirex juvencus*
- there are numerous examples of the cost of failure, e.g. pine wilt nematode in Japan, chestnut blight in the US, Ips bark beetle in Australia, pine shoot moth in Chile

The importance of pathways

- pathways are more limited than individual threats
- pathway strategies work for the unknown and unpredictable as well as the known risks
- specific studies can be undertaken to quantify pathway risks e.g. sea containers, air containers, wood packaging, and tents
- past experience can be evaluated and applied e.g. hazard sites

Prioritizing pathways

- live plant material, seed etc
- wood packaging and dunnage
- cars and machinery
- The need for review since changing trade equals changing pathways

Prioritizing groups

- often pest groups have similar damage potential and travel down similar pathways; e.g. lymantriids, bark beetles, shoot moths

An effective strategy should be pathway driven and supported by targeting of some key high-risk groups of pests and pathogens.

What Can We Do?

'Understand the nature of high risk pathways, provide effective barriers, maintain strong surveillance and respond aggressively.'

We must build on our knowledge of the risks and their associated pathways, and use this knowledge to support an integrated strategy of exclusion, detection, and response.

Information is power

- strengthen databases for both border interceptions and surveillance detections
- evaluate risk pathways through dedicated studies
- collaborate and cooperate with trading partners and international agencies on strategies of common interest

Be vigilant

- ensure effective off-shore and border quarantine
- maintain a national forest surveillance programme
- maintain and enhance a national hazard site survey and review it frequently
- ensure a core of specialist expertise and experience and access to wider skills

Be prepared

- undertake response and contingency planning at a generic level
- ensure access to operational capability by experienced staff
- ensure priority access to key science input
- ensure the availability of specialist facilities

There is a lot we can do but it needs to be done within a coherent framework, and driven by a well-defined strategy which integrates off-shore, border, and surveillance components.

What Have We Learned? 'Not much.'

The failure, in the last year or two, to apply the lessons from past successes, to learn from past mistakes, and to preserve and build on existing assets, is the single biggest failing of forest biosecurity.

The value of information

- the forest health database never more valuable,never more at risk
- the BUGS database, from collecting as much as possible to collecting as little as possible

The value of experience

- white spotted tussock moth experience not applied to painted apple moth
- $12 million spent, nothing published, forestry's core biosecurity in Forest Research increasingly underutilized

The value of collaboration

- failure to build on key collaborations and relationships with Australia, USA, Canada

The value of focus

- a future in trees is not the same as a future in carrots

We are going backwards in our commitment to forest biosecurity both at the corporate and governmental levels. Too much bean counting and not enough vision. Too much politics and not enough forestry.

What Do We Need?

'An integrated collaborative initiative, strongly led, partnership driven, and utilizing the best possible experience, expertise and facilities'

Government must promote and lead a coherent forest biosecurity strategy in partnership with the sector and the scientific community. It must be characterized by:

- Integration of off shore, border, and post border components
- Collaboration within New Zealand and overseas
- Participation by the Government, the sector, and science groups
- Commitment to long term strategies based on robust science, vigorously defended against the short-term interests of politicians, bureaucrats and bean counters

I have a plantation of 8 year old radiata which my daughter refers to as her Ferrari, she's keen we don't turn it into a Morrie Minor.