New Zealand *under* SIEGE

A review of the management of biosecurity risks to the environment

Office of the
PARLIAMENTARY COMMISSIONER FOR THE ENVIRONMENT
Te Kaitiaki Taiao Te Whare Pāremata

ACKNOWLEDGEMENTS

Investigation team

Bruce Taylor, MPP, Dip Public Health, Dip APC, Dip Acoustics (project leader)

Ewan Gebbie, B For Sc, MBA

Kathryn Botherway, BSc (Hons), from August 2000

Gill James, LLM (Hons), to April 2000

Cristina Mormorunni, BSc, to March 2000

With contributions from

Sarah Ireland, BSc, LLB (Hons)

Ronda Cooper, BA (Hons), MA

Background papers[1]

Keith Budd and Anne-Marie Arts, Agriculture New Zealand

Peter Clough and Joanna Smith, New Zealand Institute of Economic Research

Wren Green, EcoLogic Conservation Consultants

Internal reviewer

Doug Clover, MSc (Hons) (Res Mgt)

External reviewers

Ms Linda Constable, Kaupapa Taiao Manager, Office of Te Rünanga o Ngäi Tahu, Christchurch

Dr Mike Taylor, Biosecurity Research Manager, Cawthron Institute, Nelson

Mr Gary Barker, Invertebrate Ecologist, Landcare Research, Hamilton

Dr Gordon Hosking, Forest Health Consultant, Hosking Forestry, Rotorua

Editor

Red Inc and Associates, Wellington

Design/layout

typeface, Wellington

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Photographs and images

Jack Kelly Clark, courtesy University of California Statewide IPM Project

Frank Lemckert

Phil Stewart

MAF

Cameron Hay

Forest Research

Mike Barker, University of Otago

Graham Edgar, University of Tasmania

Wellington Regional Council

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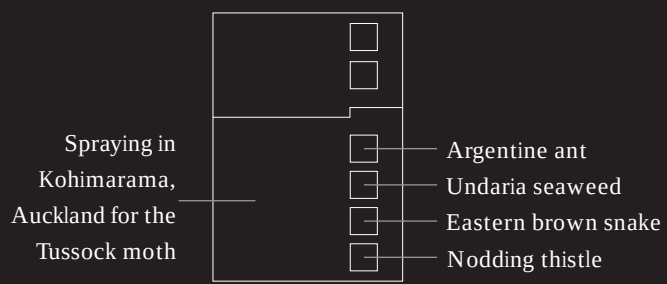

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New Zealand is under siege. Potential animal and plant pests are battering our defence systems in ever increasing numbers as volumes of goods and passengers passing through our borders soar. Our lines of defence are becoming more sophisticated but are not providing the level of protection needed to match the nature and extent of the invasion – in operational and policy terms. In some ways the current situation could be likened to a very famous battle in the skies over England in the summer of 1940. The aerial attacks were intense and sustained, the defences were thin but very determined and strongly supported by communities on the ground. Comparing New Zealand's current biosecurity scene with an air battle of 60 years ago may seem far-fetched or even irrelevant, but from what my team and I have deduced about biosecurity in New Zealand today I believe there are strong similarities, and this gives cause for grave concern. We know from history that the gallant few won the day in the air in 1940 and the pests decided to focus on another front – Russia. New Zealand's biosecurity battle is not going to benefit from any such diversion of attention. The pressure on our borders will continue to increase.

I have introduced the military analogy because the most striking feature of biosecurity for New Zealand is that it is every bit as important as national security. The invaders that pose the greatest risk to our unique ecology and biotic economy will not be two legged warriors in 21st century wakas or spitfires. They are likely to have six or more legs, be microscopic, green, hard to spot on any radar screen and great infiltrators if they slip through our defences. There are more Varroas on the invasion horizon. Our current biosecurity efforts are considerable, but I conclude they simply do not get the level of strategic focus and support that is desirable, hence my recommendation to beef up the role of the Biosecurity Council. Biosecurity should be accorded the priority and focus of national security.

How we "see" biosecurity as a nation has fundamental influences on how we evolve systems to protect our ecology and economy. New Zealand's system has evolved primarily with the aim of protecting our land-based industries, agriculture, horticulture and forestry. A biosecurity focus on indigenous flora and fauna, via the proposed Biodiversity Strategy, is a very recent phenomenon. The land-based industry focus of the biosecurity effort, with its policy home in Agriculture Ministries, plus 20 years of evolution while New Zealand has been very focused on trade liberalisation, has created a policy and institutional philosophy dominated by attention to cost effectiveness, efficient processes and apportioning costs - possibly at the expense of focus on the unique biosecurity needs of New Zealand. During the course of this investigation my team were told of New Zealand's world-leading biosecurity system. Aspects of our system are top notch but making global comparisons is of little real value. New Zealand's needs are uniquely different. Our distinctive biodiversity and biotic economy are not replicated anywhere else on the planet. For this reason our biosecurity goals and performance standards have to be truly New Zealand specific. They should not be compromised by international agreements that may or may not accommodate our unique needs.

This investigation follows recent reviews of aspects of biosecurity. My approach has been to identify strengths and weaknesses of the current legislation and systems and then to recommend courses of action. Given the importance of biosecurity to New Zealand's future, I have also endeavoured, through this report, to provide a framework against which I can audit future progress of biosecurity management. I anticipate assessing progress via a rich mix of "indicators", including such simple ones as whether or not we have successfully eliminated risk pathways such as flood damaged motor vehicles.

My principle recommendations are to the Minister for Biosecurity. The intent of these recommendations is to encourage biosecurity to be accorded a much higher profile (ie aligned with national security), ensure that biosecurity outcomes are more explicitly laid out, ensure that biosecurity for biodiversity purposes is enhanced and that investment in biosecurity, particularly education, surveillance and emergency response, is increased. In making these recommendations I am aware of ongoing efforts to improve the current systems and I commend them. However, I do not believe they go far enough, particularly in terms of revising the roles and functions of the Biosecurity Council.

Finally, the continual improvement of our biosecurity systems has to be based on a partnership between government, business and the community. Developing the partnership and empowering communities to be part of the system will take more time and money. I trust all participants will appreciate the value (fiscal and non-fiscal) in the investment. Failure to do so will simply mean alien invaders will continue to erode our natural capital and our trading competitive advantages.

Dr J Morgan Williams

PARLIAMENTARY COMMISSIONER FOR THE ENVIRONMENT

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Key Messages

1. Trade and tourism are vital to the New Zealand economy. Unfortunately imported goods, mail and travellers (visitors and returning residents) are pathways for introducing pests, diseases and other unwanted organisms that threaten our economy, biodiversity, ecosystems and public health. New pests and diseases in turn create risks for future exports and conservation tourism because they can affect the very features that New Zealand's trade and tourism sectors depend upon.

   Biosecurity is, therefore, as strategically important as national security when it comes to protecting New Zealand's key economic and environmental assets. However, it has not been accorded such strategic status nor investment that even begins to approach the amount the Government spends on national security matters.

2. New Zealand's indigenous biodiversity is in decline due, among other things, to the effects of an increasing number and variety of deliberately or accidentally introduced plants and animals that have become pests in the terrestrial, freshwater and marine environments. Management of risks to indigenous flora and fauna, biodiversity, and ecosystem and public health needs to receive greater prominence across all parts of the biosecurity system. These parts include international agreements, assessment of high-risk pathways and organisms, research, monitoring and surveillance, emergency response, pest and disease management, and public awareness of and participation in biodiversity and biosecurity strategies and programmes.

3. Biosecurity emergency management funding and strategies need clarification to ensure that responsibilities are clear and resources are available for rapid and effective responses to biosecurity breaches and incursions. Capacities within agencies to advise on and respond to emergencies also need to be improved, particularly in relation to risks to indigenous flora and fauna.

Summary of Findings

The following is a summary of the strengths and weaknesses of the current biosecurity system, and some opportunities for making improvements in terms of the strategic, process and operational aspects of the system. The background and analysis, which supports this summary, is contained in sections 2 to 10, Appendices A and B, and in the background papers that have been commissioned as part of this study.

The weaknesses and opportunities identified in this section will form the basis on which the Parliamentary Commissioner for the Environment (PCE) will assess the environmental outcomes of current and future developments in biosecurity structures, legislation, strategies or priorities.

4. The role, functions and responsibilities of the Biosecurity Council and its consultative forums need to be substantially revised to ensure that the Minister for Biosecurity receives timely and appropriate advice. Issues a revamped Council needs to address include:
   - strategic directions for biosecurity, particularly in relation to indigenous flora and fauna, biodiversity, and ecosystem and public health
   - the biosecurity implications of international agreements
   - biosecurity priorities, including research priorities, monitoring and surveillance needs, and allocation of funding among biosecurity agencies
   - co-ordination of agencies' biosecurity outputs
   - evaluation of biosecurity outcomes and the effectiveness of the biosecurity system
   - biosecurity capacity issues (ie the resources and expertise needed to operate effectively)
   - processes for consulting with Maori on biosecurity issues
   - opportunities to involve a wider range of stakeholders in biosecurity risk management.

5. The proposed Biosecurity Strategy needs to explicitly state the Government's outcomes and objectives for biosecurity. The Biosecurity Act 1993 then needs to be reviewed to ensure that it enables biosecurity agencies, through their implementation of the Act, to achieve those outcomes and objectives.

Strengths of the biosecurity system

Strategic strengths

a) As an island nation, geographically isolated from its neighbours, New Zealand has been fortunate in not being invaded by exotic species to the extent that other land-locked countries have. This gives us economic advantages, such as pest-free exports and unique experiences for tourists. But this advantage also means that we are faced with relatively high costs of protecting what we have in terms of indigenous flora, fauna and biodiversity, some of which may be unable to cope with the invasiveness of some exotic species.

b) Co-ordination by the Biosecurity Council of strategic policy advice on biosecurity matters (see section 3) is a significant strength of the biosecurity system. It fosters good working relationships among the four government departments that have responsibilities for biosecurity outputs, and the regional councils. It also provides the Minister with advice from a number of perspectives.

c) New Zealand is a party to the Convention on Biological Diversity (CBD), a multilateral environmental agreement established to implement global objectives in conserving biological diversity, sustainable use of the components of biological diversity, and equitable sharing of genetic resources (see section 7).

d) MAF has achieved international recognition for its involvement in managing biosecurity risks to agriculture and trade through the World Trade Organisation Agreement on the application of Sanitary and Phytosanitary Measures, the Interim Commission on Phytosanitary Measures, and the Office International des Epizooties (see section 7).

e) MAF Biosecurity Authority has a pivotal biosecurity policy development role and provides secretariat services for the Biosecurity Council. It contains most of the technical resource necessary for undertaking biosecurity risk analysis, the development of import health standards (mainly in relation to primary production), border control and emergency response (see section 3).

f) Managing biosecurity risks at the border is a key aspect of biosecurity, and the Government invests a significant proportion of biosecurity funding into this area. Over $38 million (47.7% of Votes: Biosecurity) is being spent on border operations in 2000/01 (see section 3).

g) The Invasive Species Specialist Group of IUCN (the World Conservation Union), located at the University of Auckland, was one of the implementing agencies involved in the development of the 'Action Strategy for Nature Conservation in the Pacific islands region, 1999-2002'. The South Pacific Regional Environment Programme (SPREP), on behalf of all the implementing agencies, produced the strategy. The Ministry of Foreign Affairs and Trade (MFAT) provided funding to IUCN to support its work in this area over three years. The Invasive Species Specialist Group has also been instrumental in developing the IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species (see sections 5, 7 and 8).

h) In its June 2000 Budget, the Government announced a five-year funding package to support the implementation of *The New Zealand Biodiversity Strategy*. This includes funding for the development of a Biosecurity Strategy, which is intended, among other things, to enhance New Zealand's biosecurity capability and the assessment of biosecurity risks to indigenous flora and fauna (see section 8).

Process strengths

a) Since its establishment in mid-1999, MAF Biosecurity Authority has been producing a number of policies, discussion papers and guidelines relating to the implementation of the Biosecurity Act. Examples include:

- a consultation policy, which sets out its approach and the requirements it has of its staff in relation to consultation on risks, import health standards and other matters for which it is responsible (see section 4)
- proposals for a policy on 'appropriate level of protection against risk' (MAFBA, 2000b), which will set out a 'managed risk' approach and help in determining acceptable levels of biosecurity risk, acknowledging that 'zero risk' in biosecurity is unattainable
- an information paper, for central government biosecurity agencies and regional councils, on options for managing harmful organisms (MAFBA, 2000c)
- a proposal supported by the Pest Management Strategy Advisory Committee for continuing the 'national surveillance pest plant initiative', involving regional councils and unitary authorities (see Appendix B)
- a description of MAF's biosecurity (phytosanitary) system (see section 3).

b) The Biosecurity Council has developed policy statements on national pest management strategies, interdepartmental consultation on risk analysis, and unwanted organisms. Other issues under consideration include the application of 'precaution' in managing biosecurity risks, conducting import risk analysis, and incursion responses (see section 3).

Operational strengths

a) Approximately $1.5 million is spent each year on biosecurity risk research funded through biosecurity agencies' operational research budgets, the Public Good Science Fund and the private sector (see section 5). However, such research represents only a relatively small component of biosecurity agencies' research budgets.

b) New Zealand biosecurity agencies successfully eradicated the white spotted tussock moth in 1997. Other eradication efforts (eg the banjo frog) are still being monitored to determine how successful the attempts have been. There are specific cases where central and local government agencies have successfully combined resources in attempts to eradicate pests (see Appendix B).

c) The rate of detection of biosecurity risks from incoming passengers and luggage at the main international airports has markedly improved since the introduction of x-ray scanners and detector dogs, despite aircraft arrivals having increased significantly in the last seven years. X-ray scanners and detector dogs now scan all arriving letters and packages from overseas (see section 5).

d) Regional councils play a significant role in the ongoing management of plant and animal pests that have become established in New Zealand. They spend over $40 million per year on pest management, half of which is funded through the Animal Health Board (for Tb control) (see section 3).

e) Discoveries of biosecurity incursions are not necessarily an indication that the system has failed, but rather evidence of successful vigilance and awareness. The public has played a significant role in discovering some incursions in the past, and this needs to be encouraged in the future through public awareness campaigns (see section 4).

Weaknesses of the biosecurity system

Strategic weaknesses

a) Biosecurity is not recognised as being as strategically important to New Zealand as national security.

b) There is a strong emphasis on maintaining trade relationships and complying with trade liberalisation agreements, such as the Agreement on the Application of Sanitary and Phytosanitary Measures, and avoiding barriers that cannot be scientifically justified. In contrast, another important commitment is to the precautionary approach of the Convention on Biological Diversity, to which New Zealand is a party (see section 7). The different objectives and underlying principles of these agreements have the potential to clash.

c) It can be difficult to accurately predict the arrival of exotic organisms and whether any of them will survive and significantly affect native species, especially if no host testing has been carried out. There may be insufficient information on the 'threats' and the 'threatened' to enable appropriate risk management strategies to be developed (see section 2).

d) Biosecurity breaches and incursions are inevitable. No system can provide total protection against unwanted organisms. Apart from the practical difficulties of implementing a 'zero-risk' approach to biosecurity, it would be costly to implement and would affect trade. Instead, it is important to establish appropriate levels of protection that will determine the measures needed to manage biosecurity risks (see section 3).

e) Biosecurity is not an end in itself. It is a means to achieve outcomes such as the protection of primary production systems, human health, indigenous flora, fauna and biodiversity from harmful organisms, and to maintain or improve ecosystem health. The present biosecurity system does not have a clear set of outcomes, making it difficult to measure the success or otherwise of the system (see section 3).

f) There has been slow progress in developing strategic directions for biosecurity, including policy, research and operational priorities across all sectors, but especially in relation to biosecurity risks to biodiversity, indigenous flora and fauna, and ecosystem health (see section 2).

g) There is a lack of policy on appropriate public/private sector contribution to biosecurity funding consistent with exacerbator/beneficiary responsibilities. While biosecurity measures to protect indigenous flora and fauna, biodiversity, and ecosystem and public health are generally in the public interest and should, therefore be publicly funded, private sector contributions for the following need to be reviewed:

- import health standards
- compliance checking and clearance of import and export goods and vessels
- surveillance of private sector estates and reporting of results
- incursion response, depending on the nature and effect of the incursion
- ongoing pest and disease management (see section 3).

h) There are weaknesses in the Biosecurity Act arising from the lack of an over-arching purpose, reference to Treaty obligations and, generally, its emphasis on 'empowering' rather than 'requiring' agencies to act, creating the potential for situations to arise where agencies 'opt out' of their involvement in biosecurity (see section 3 and Appendix A).

i) MAF receives around 95% of the Government's biosecurity funding. MAF's focus up to now on risks to primary production and trade has strongly influenced the direction of biosecurity. Since 1999 MAF Biosecurity Authority has had a pivotal role in the co-ordination of biosecurity agencies and consultative groups, and in the delivery of border control services. MAF Biosecurity Authority now needs to demonstrate that greater attention will be given to biosecurity impacts on indigenous biodiversity. More emphasis also needs to be placed on the management of biosecurity risks to marine ecosystems (see section 3).

j) Current funding arrangements for responding to biosecurity emergencies create uncertainties for the biosecurity agencies involved, and there is a potential for financial constraints to lead to sub-optimal responses to some incursions (see section 3).

k) The compliance costs and complexities of the Hazardous Substances and New Organisms (HSNO) Act process for approval to introduce new plant material, and the lack of awareness of the Act's requirements, are believed to be the causes of the very few such applications to the Environmental Risk Management Authority (ERMA). There is already evidence (eg mail containing smuggled plants and seeds intercepted at Auckland International Mail Centre) that this is adding to pressures on the biosecurity system. However, any modifications to the HSNO Act process for new plant material or other organisms should not compromise the requirement to consult.

Process weaknesses

a) The system and processes for managing biosecurity risks to New Zealand need to ensure that, as far as possible, all interests, values and expectations are taken into account. Evidence indicates that potential impacts of pests on native flora are not always brought to the attention of the Government (see Appendix B case study on the painted apple moth). There is also evidence that on some forestry-related issues, MAF Biosecurity Authority's consultation with stakeholders could be improved (see section 4).

b) The lack of processes for consulting with Maori on biosecurity issues is inconsistent with other institutional and legislative frameworks dealing with concerns about organisms being introduced into New Zealand (eg the HSNO Act). There is a need to acknowledge Treaty obligations and to encourage tangata whenua input, and the contribution that traditional knowledge can have to decision-making and setting priorities (see section 9).

Operational weaknesses

a) Pre-border and border controls can only reduce the likelihood of a detectable organism getting through the system. It is important that effective back-up post-border management systems are in place to prepare for and provide an appropriate response when (not if) incursions happen. This involves emergency management plans and resources to deal with initial responses (such as eradication programmes) and/or ongoing management (such as pest management strategies).

b) Pre-border and border controls need to place more emphasis on managing *pathways* by which exotic organisms may arrive in New Zealand, not just strategies to exclude individual pests.

c) Expenditure by MAF Quarantine Service on public awareness has declined in recent years from about $500,000[2] to $86,000. In contrast, the Australian Quarantine Inspection Service (AQIS) budget for quarantine awareness for 2000/01 is AU$ 2.2 million (approximately NZ$ 2.86 million). Increased funding is needed to maintain an effective public awareness campaign that draws attention to the risks and encourages international traders and travellers, and New Zealand residents, to accept their responsibilities for biosecurity (see section 2). This needs to be supported by increased penalties for non-compliance with biosecurity requirements.

d) The rate of detection of unwanted organisms at New Zealand's major international airports has improved markedly over recent years due to improved detection techniques. However, in the long term this may be off-set by the increasing volumes of passengers and goods coming into New Zealand, the speed with which they get here, and the wide range of countries from which they originate (see section 5).

e) Biosecurity risks to indigenous flora and fauna are less well defined, analysed and researched than risks to the production of, and export access for, primary produce. Both commercial and indigenous plants and animals (terrestrial and marine) are valuable to New Zealand's economy and environment, and need to be adequately protected. It is important to have a good understanding of the risks and the range of animals and plants that are 'at risk'. DoC and MFish have only a relatively small budget for operational research on biosecurity risk management. Both DoC and MFish need to reassess their research budgets and priorities to ensure that risks to indigenous flora and fauna, biodiversity and marine ecosystems are properly assessed (see section 5).

f) In contrast to the level of resources applied to the monitoring and surveillance of terrestrial invasive species, data on alien species in New Zealand's coastal marine environment and harbours have been non-existent to poor. There is such a lack of baseline data and basic taxonomic expertise that it has been difficult to determine if many marine species here are native or alien (see the background paper by Green (2000), and section 5).

[2] *This was a one-off payment in 1996/97.*

Opportunities to improve the biosecurity system

Strategic opportunities

a) New Zealand's unique but declining indigenous biodiversity, geophysical features and reliance on biological assets highlight the importance of seeking our own solutions to biosecurity risks. We should not rely solely on adopting biosecurity policies and systems developed in other countries. Nor should we attempt to benchmark New Zealand's biosecurity system against other countries whose natural characteristics differ from those of New Zealand. New Zealand's biosecurity needs are unique and for some of our indigenous species we may need a higher standard of biosecurity protection than exists elsewhere.

b) New Zealand cannot rely on border inspection of goods and passengers entering New Zealand as its 'first (and only) line of defence' against unwanted organisms. The actual first lines of defence are preventive measures such as:

- international agreements (see section 7)
- import health standards for risk goods (see Appendix A)
- pre-border checks and certification of risk goods prior to their export to New Zealand (see section 5)
- 'early warning' systems, intelligence-gathering and information-sharing to enable agencies to prepare for potential incursions (see section 5).

c) A broad set of risk management principles need to be developed, as part of the Government's proposed Biosecurity Strategy, covering:

- pre-border (off-shore) measures to reduce the threat of entry
- risk-based border controls
- monitoring and surveillance for the early detection of incursion and spread of harmful organisms
- emergency response strategies to contain, control or eradicate interceptions and incursions
- ongoing pest and disease management
- resource and information sharing
- public education strategies and funding to improve awareness of the risks (see section 2).

d) The multiple-agency, fragmented approach to biosecurity has the potential to be inefficient and ineffective unless there is good co-operation and linkages between agencies. The Biosecurity Council provides this opportunity and its role in this area needs to be substantially improved. Under the co-ordination of the Biosecurity Council, biosecurity agencies need to review their capacities to undertake biosecurity responsibilities, and address areas where gaps, overlaps or other deficiencies may affect the delivery of their statutory functions or their relationships with other biosecurity agencies. Inter-agency co-operation in decision-making should also include input from the private sector, non-governmental organisations (NGOs) and science providers (see section 3).

e) In the research component of the Government's proposed Biosecurity Strategy a collaborative arrangement among biosecurity agencies and their research providers needs to be encouraged. Information management and sharing is essential for successful multiple-agency structures, and needs to be addressed in the proposed Strategy (see section 5).

f) MAF has been funded to be the lead agency on biosecurity risk assessment and management and border protection, and to facilitate responses to incursions. It is important, therefore, that, under the direction of the Biosecurity Council, MAF establishes formal agreements with other agencies to ensure that:

- all interests in biosecurity risk management are taken into account
- best use is made of existing expertise in all areas of biosecurity
- responsibilities and accountabilities are clear
- information is shared and transferred in a timely and effective manner.

Process opportunities

a) A range of measures, such as targeted messages to overseas visitors and returning residents, and heavier penalties, needs to be considered to discourage biosecurity breaches (see section 4).

b) A precautionary approach to biosecurity risk management is needed in relation to potential risks to indigenous flora and fauna and marine ecosystems where the information needed to make informed decisions is limited, uncertain or does not exist (see section 4).

Operational opportunities

a) The annual costs to New Zealand of damage by pests, weeds and diseases, and the expenditure by central government, regional councils and the private sector to combat them, are high and increasing. The effectiveness of investment in biosecurity, in terms of reduced risk, less environmental damage and improved ecosystem health, needs to be assessed to ensure that outcomes are being achieved.

b) Biosecurity agencies need to strengthen (and share information from) their monitoring, surveillance, research and intelligence systems to help identify recurring or emerging biosecurity risks (especially in the case of the marine environment). This will enable them to be better prepared to target and manage such risks, and for the system to be adapted to manage the risks. Active surveillance needs to be risk-based – looking for the right things in the right places at the right time. In order to make best use of limited biosecurity resources, high-risk countries, visitors and pathways of imported goods should be closely monitored to track current, and identify emerging, biosecurity risks (see section 5).

c) Auckland is the country's highest risk entry point for exotic terrestrial pests and diseases (see section 5). It has this distinction because of:

- the volume of imported goods via sea and air
- the number of international passenger arrivals and where they travel from
- its climate, vegetation and other natural characteristics that support pest plants or animals
- its record of interceptions and incursions.

This highlights the importance of having a high level of vigilance and encouraging support from communities in the Auckland region to help identify/detect unwanted organisms. Increasing awareness in schools is an important component. Similar programmes should also be extended to Tauranga, Wellington, Christchurch and any other urban areas with an international airport or port. Cargo handlers and importers also need to be involved. Local authorities in these areas could make a significant contribution to improving public vigilance.

d) Information from MAF Quarantine Services on the type and range of organisms being detected and intercepted at the border (and the sources and pathways) should be fed back into MAF Biosecurity policy development, research, standards-setting, and the monitoring carried out by other agencies such as the Department of Conservation (DoC) (see section 5).

e) Successes and failures of biosecurity agencies' responses to pest and disease incursions need to be analysed in order to learn from their experiences and to improve operational capabilities and techniques. Agencies should also be willing to consider the value of 'learning by doing' when faced with a new type of incursion. Conventional assessments of eradication probabilities may not be an appropriate way of predicting the likely success of an eradication programme. Where appropriate, biosecurity agencies should take the opportunity to research eradication techniques and refine their programmes while they are in progress (see sections 3 and Appendix B).

f) Effective biosecurity cannot be achieved by a single government agency. It requires a partnership approach involving central and local government, industry, tangata whenua, research organisations and non-governmental organisations in biosecurity policy development, and engaging the general public in the management of biosecurity risks (see section 2). Such a partnership will improve the consideration given to the effects on the natural environment of harmful organisms. Where necessary, the combined resources of central and local government agencies, and those of the private and voluntary sectors, should be utilised to deal with incursions (see Appendix B). Agencies such as DoC, MAF, the Ministry of Health (MoH) and regional councils have staff or service delivery agents 'on the ground' who could be an effective resource for undertaking monitoring, surveillance and incursion response work.

g) Operational research should include assessment of the risk of harm to indigenous flora and fauna by exotic pests and disease incursions (such as host testing), and research into major and emerging pathways for alien species. Research on public perceptions and attitudes to biosecurity should also be ongoing (see sections 4 and 5).

1.1 Aims

Historically, most of the biosecurity effort in New Zealand has gone into supporting systems that were mainly designed to protect our agricultural, horticultural and forestry industries from the adverse effects of exotic pests, diseases and other harmful organisms. The motivation for this has been the extent to which our economy relies on trade in primary products. But another factor, less well recognised in the past, is the importance of protecting our unique indigenous biodiversity, flora and fauna, landscapes and ecosystem health from harmful organisms.

In addition, most of the attention given to managing biosecurity risks has been in the terrestrial environment, while in the marine environment invasive species may go undetected until the harm becomes evident and, in some cases, irreversible.

The aim of this review of New Zealand's biosecurity system was to determine, from an environmental management perspective, whether the systems and processes in place are adequate to meet New Zealand's biosecurity needs. In particular, the review set out to:

- review New Zealand's biosecurity systems,[3] strategies, processes[4] and outcomes[5] from an environmental management perspective (a broad scan of the biosecurity system)
- focus on and analyse, where appropriate, key aspects of biosecurity risk[6] management (a targeted analysis of actual or potential gaps in the biosecurity system).

The overall purpose was to:

- identify any gaps or weaknesses, and highlight the strengths, of the current system for managing biosecurity risks to the environment
- table a report in Parliament with recommendations on any changes to the biosecurity system that may be necessary to maintain and improve the quality of the environment.

[3] *Including legislation, institutions, structures, funding, co-ordination and accountabilities.*

[4] *Including central and local government policies, programmes and procedures.*

[5] *Results expected and achieved by the Government from the systems, strategies, processes and funding of New Zealand's biosecurity system.*

[6] *Including risks to New Zealand's biodiversity, economy, cultural values and public health.*

The biosecurity system 'weaknesses' and 'opportunities' identified in this report are intended to form the basis of any future review by the PCE of progress in implementing changes arising from the Government's commitment to *The New Zealand Biodiversity Strategy* (New Zealand Government, 2000a). The funding package announced by the Government in June 2000 includes the development of a Biosecurity Strategy and systems to enhance New Zealand's marine biosecurity.

1.2 Background

In February 1997 during a symposium to review the first ten year's work of the PCE (Hawke, 1997), biosecurity was raised as an issue that warranted a PCE investigation. There was concern about the whole philosophy underlying the development of biosecurity legislation and policy, where the focus was on assigning costs rather than achieving particular biosecurity goals. While these concerns were noted biosecurity was not identified as a priority area for investigation in the PCE's 1997 strategic plan (PCE, 1997). Investigating environmental management in urban and marine systems was accorded higher priority at that time.

In mid-1999 participants in a forum organised by the PCE to review the directions of the Office (see PCE, 1997) identified, as a priority, the need to investigate New Zealand's biosecurity system.[7] Also, in his 1999 report on managing New Zealand's marine environment (PCE, 1999), the PCE highlighted some of the current and potential marine biosecurity threats, including those likely to have been transported by ballast water and hull fouling. One of the themes discussed in the Government's *New Zealand Biodiversity Strategy* is biosecurity and biodiversity. The Strategy sets out a number of objectives for the management of biosecurity risks to biodiversity.

On the basis of these comments and reports, and after a number of preliminary discussions with a range of stakeholders between December 1999 and March 2000, the PCE decided that he could make a constructive contribution to biosecurity management by undertaking an independent review of the environmental management aspects of the current system.

[7] *See also the PCE's Strategic Plan Update, December 1999.*

1.3 Methodology

To accomplish its purpose, the review involved:

- consulting with stakeholders (including central and local government agencies, tangata whenua, non-governmental organisations, research and science providers, primary production industries, importers and exporters, port companies, international transport operators, local communities)
- examining documentation (including policies, plans, strategies, risk assessment reports and published material)
- case study reports on a number of biosecurity issues (including examples related to particular alien species, incursion pathways and inter-agency responses) and the lessons to be learned (including changes to structures, processes, policies, resources, service delivery and other components of the biosecurity system)
- background reports[8] on:
  - a summary and analysis of changes to New Zealand's biosecurity system over the last decade or so (a look back)
  - current and emerging ecological risks to New Zealand and the challenges these will bring to our biosecurity system in the foreseeable future (a look forward)
  - key economic issues facing New Zealand's biosecurity system and how these are likely to influence biosecurity decision-making
- visits to biosecurity facilities, including border and post-border control and surveillance facilities
- discussions with the Australian Quarantine Inspection Service, Agriculture, Fisheries and Forestry Australia, and Environment Australia.

[8] *Background reports will be available on the PCE's web site: http://www.pce.govt.nz/*

1.4 Terms of reference

The review was carried out in accordance with the functions of the PCE under section 16(1)(a) of the Environment Act 1986. This enables the Commissioner:

> *...with the objective of maintaining and improving the quality of the environment, to review from time to time the system of agencies and processes established by the Government to manage the allocation, use, and preservation of natural and physical resources, and to report the results of any such review to the House of Representatives and to such other bodies or persons as the Commissioner considers appropriate.*

The objectives of the review were to examine, comment on and make recommendations in respect of parts of the biosecurity system that may need to be improved from an environmental management perspective, including:

1. the systems, strategies and processes established by the Government to manage biosecurity risks, including the assessment and prioritisation of risks (individual and cumulative), and accountability for outcomes
2. the development and implementation of an overall strategy guiding New Zealand's biosecurity system
3. New Zealand's efforts to:
   - prevent entry of unwanted organisms (pre-border)
   - detect and intercept biosecurity threats (at border)
   - control or eradicate biosecurity incursions as well as established pests and weeds (post-border)
   - control the export from New Zealand of organisms likely to be a biosecurity threat to importing countries
4. the allocation of resources among agencies in central and local government with responsibilities for managing biosecurity risks to terrestrial, freshwater and marine ecosystems, including issues of capacity, capability and co-ordination
5. attitudes among stakeholders to biosecurity risk management
6. attention given to increasing public awareness about biosecurity threats
7. consultation with tangata whenua on biosecurity risk management
8. international commitments and obligations that impact on New Zealand's biosecurity
9. availability of information on terrestrial, freshwater and marine biosecurity risks, and efforts to identify, prioritise and undertake research in those areas
10. generally, the strengths, weaknesses, pressures, constraints and other significant factors that influence the effectiveness of New Zealand's biosecurity.

1.5 Expectations

As a basis for determining the effectiveness of New Zealand's biosecurity system, the PCE expected that the following features would be present:

- comprehensive biosecurity and related legislation that facilitates integrated management of biosecurity, and adopts a precautionary approach to managing risks to the environment
- clear outcomes, accountabilities and effective co-ordination of strategies among public authorities with biosecurity responsibilities
- availability of a range of biosecurity control measures and allocation of resources determined on the basis of risk
- strategic risks to New Zealand categorised and prioritised
- biosecurity risks and outcomes are regularly monitored and reviewed
- affected parties consulted on biosecurity programmes, pest management strategies, risk assessments, risk management proposals and public awareness programmes
- biosecurity systems, processes and outcomes consistent with the principles of the Treaty of Waitangi and appropriate consultation having taken place
- response/eradication/control programmes not giving rise to significant adverse and/or irreversible environmental effects
- regional councils' pest management strategies having a consistent approach to biosecurity risks of national significance
- emergency response plans developed and adequate contingency funds available to deal rapidly with high-risk incursions.

1.6 Matters not included in this review

The review *did not*:

- examine matters dealt with in other reviews, such as the previous Government's border control review (New Zealand Government, 1999)
- analyse the entire biosecurity system in-depth, but instead concentrated on those parts of it that are deficient or potentially weak from an environmental management perspective
- deal with issues associated with biotechnology or matters related to genetic modification, which are under consideration by the Royal Commission of Inquiry
- address matters that are the responsibility of the Environmental Risk Management Authority, except where links between the Hazardous Substances and New Organisms Act 1996 and the Biosecurity Act 1993 needed to be explained.

The significance of biosecurity to New Zealand's economic, environmental and social interests has been the subject of a number of reports in recent years, most of which are referred to throughout this report. This section focuses on why the environmental management aspects of biosecurity are so important to New Zealand.

2.1 What is biosecurity?

'Biosecurity', in the New Zealand context, is not defined in legislation but various authors have described it as:

- the management of risks arising from pests, weeds and diseases, whether exotic or endemic (MAF, 1999a)
- the cost-effective protection of any natural resources from organisms capable of causing unwanted harm[9]
- the protection of natural and physical resources and human health by excluding, eradicating or effectively managing pests and unwanted organisms, and preventing or managing the adverse effects of new organisms (Sinner and Gibbs, 1998a)
- ensuring effective management of risks posed by pests, weeds and diseases consistent with objectives for biological security of the economy, biological diversity and people's health[10]
- the protection of people and natural resources, including biodiversity, from unwanted organisms capable of causing harm (New Zealand Government, 2000)
- the effective management of risks posed by pests, weeds and diseases by a system of co-ordinated pre-border, border, management and sector responses aimed at preventing the establishment and spread of organisms that may have adverse effects on the economy, environment and people's health (MoRST, 1998)
- protection from the risks posed by organisms to the economy, environment and people's health through exclusion, eradication and control (Biosecurity Council, 2000).

In summary, biosecurity could be described as the management of exotic biological risks that may harm New Zealand's economic, environmental and social interests. But it also includes the management of risks arising from the translocation of species from their natural range within New Zealand. Biosecurity is the means by which these risks are managed rather than being an end in itself.

[9] *Government Estimates, 1997.*

[10] *Strategic Result Areas for the Public Sector, 1997 – 2000.*

2.2 The significance of biosecurity to New Zealand

Unlike countries in Europe, North and South America, Africa and Asia, which have political rather than physical boundaries, New Zealand is an 'island nation' with unique biological characteristics that are highly valued yet taken for granted. As pointed out in *The New Zealand Biodiversity Strategy* (New Zealand Government, 2000a, p 3):

> *Biodiversity is New Zealand's biological wealth. We base much of our economy on the use of biological resources, and benefit from the services provided by healthy ecosystems. These 'ecosystem services' include producing raw materials (principally food from the sea and fibre from the land), purifying water, decomposing wastes, cycling nutrients, creating and maintaining soils, providing pollination and pest control, and regulating local and global climates. Yet we tend to take these services for granted because they are provided free of charge by nature.*

The benefits from biological resources and healthy ecosystems may be diminished or irretrievably lost by the careless introduction of pests and diseases. New Zealand's unique natural characteristics, which are already in decline (see section 8) due to some already-introduced species, continue to be at risk from organisms arriving via imported goods and tourists. In a briefing to the incoming Minister for Biosecurity in December 1999 (DoC, 1999), the Department of Conservation pointed out that:

> *Introduced invasive species pose the single largest threat to the survival of many of New Zealand's threatened species and ecosystems. Better assessment and management of the biosecurity risks to native flora and fauna is needed if we are to arrest the current decline of New Zealand's unique biodiversity.*

International research into global change has come to the consensus that invasion by alien species is the second most important global influence on biodiversity loss after land-use change (Green, 2000).

2.2.1 A trading nation

Since European colonisation, New Zealand has relied extensively on the export of its agricultural products. Up until 1915, 90% of trade was with the United Kingdom and Australia. New Zealand now trades with a far wider range of countries and with much larger volumes of goods and commodities (Green, 2000). New Zealand's major trading partners, in terms of imports, are Australia, Japan and the US.

In the year ending June 1997 New Zealand's three major export commodities (in terms of value) were dairy produce (16.8%), meat and edible offal (13%), and wood and articles of wood (7.4%). Exports of fish, including shellfish, accounted for about 4.9% of products exported. The three largest destinations for New Zealand's forestry products were Japan, Australia and Korea (Statistics New Zealand, 1998).

New Zealand-produced exports in 1998/99 totalled nearly $21.8 billion and agricultural, horticultural, fisheries and forestry sectors collectively accounted for 70 percent of the export receipts (Rauniyar *et al.*, 1999).

As an example of recent trends in trade-related biosecurity risks, imported used vehicles have received a great deal of attention due to the risk of their carrying egg masses of the Asian gypsy moth. In the year ending June 1997, vehicles were the second highest percentage (by value) of imports (12.7%). Japan was the largest supplier of used vehicles to New Zealand at 95.5% of the total number imported.

2.2.2 Protecting assets

New Zealand's biological assets characterise the essence of 'New Zealand' (eg the silver fern, kiwi and other iconic species) and influence how the country is perceived by trading nations and visitors. Freedom from arboviral diseases, such as dengue fever in humans, is also an important asset worth protecting (see section 10). Primary products, and other biological assets that New Zealand's trade and tourism rely on, are highly vulnerable to pests and diseases, many of which will be introduced via imported goods or passengers arriving in the country.

The potential disruption that exotic pests and diseases could have on the country's economic, environmental and social fabric emphasises the importance of having an effective biosecurity system. An effective biosecurity system is more important for New Zealand to maintain its environmental qualities and support its economy than for many of our trading partners. Biosecurity is in the national interest. It is as important as national security and civil defence in the sense that it is essential for the protection of the country's key strategic asset – its natural resources. Failure to provide an effective system could have serious consequences for New Zealand's economy, environment and public health.

2.2.3 Biodiversity at risk

New Zealand has a unique, but declining, indigenous biodiversity. As stated in *The New Zealand Biodiversity Strategy*:

> *New Zealand's high level of endemic biodiversity makes a unique contribution to global biodiversity... Our indigenous biodiversity – our native species, their genetic diversity, and the habitats and ecosystems that support them – is of huge value to New Zealand and its citizens; to our economy, our quality of life, and our sense of identity as a nation. However, since humans first settled in New Zealand, our biodiversity has been in decline – through species' extinction, loss and disruption of natural areas and ecosystems, and the effects of an increasing number and variety of introduced plant and animal pests... Increasingly, New Zealand's international reputation and trade opportunities will depend on our performance in maintaining a quality natural environment, of which biodiversity is a key element.*

2.3 The threats and the threatened

2.3.1 The threats

Threats to New Zealand's biosecurity include both the individual species themselves and the pathways by which they gain entry into New Zealand, whether by natural, deliberate or unintentional means. MAF estimates that about 50 new organisms enter New Zealand every year.[11] The threat depends on the likelihood of a pest or disease arriving in New Zealand and surviving, and the environmental, economic and public health consequences if it does. The combination of likelihood and consequence constitutes the 'risk'. Examples of threats from terrestrial, freshwater and marine invaders, as well as various pathways, are discussed in a background paper to this report (Green, 2000). The case studies in Appendix B also highlight some of the characteristics of pests and diseases that have initiated recent biosecurity responses.

There is such a vast number of plants, diseases, animals and microbes that could arrive in New Zealand and that may or may not be detected or become established that it is difficult to predict the likelihood and consequences of each introduction. The only certainty is that biosecurity breaches and incursions *will inevitably occur* despite measures to prevent them. Pre-border and border controls can only reduce the likelihood of a detectable organism getting through the system. It is important that effective back-up, post-border management systems are in place to prepare for and provide an appropriate response when (not if) incursions arise. This involves pest management strategies, emergency management plans and resources to deal with initial responses (eg eradication programmes) and/or ongoing management (eg pest control programmes).

[11] *These new pest records include species found for the first time in New Zealand (ie new to New Zealand records). There is no way of knowing how long some of them have been here, and if some are endemic species not discovered earlier (MAF, comments to the PCE, 10/11/00).*

2.3.2 The threatened

The 'threatened' include the unique flora, fauna, biodiversity and ecosystems that characterise New Zealand.
Also threatened is our ability to trade in primary products and the impact this may have on New Zealand's economy.
The latter has traditionally received greater attention, in terms of resources and research. Some parts of New Zealand are under greater threat than others due, for example, to their location, climate and host species (eg around international airports or ports in the North Island). The extent to which some parts of the environment are threatened (eg the marine environment), and the long-term consequences of being under threat (eg on public health, ecosystem health and biodiversity) are not well understood. For further commentary on this, see sections 8 and 10 and Green, 2000.

Alien invasive species have caused extinctions and degraded ecosystems on every major landmass, particularly on island countries. The flora and fauna of islands, after millions of years of geographical isolation and speciation, often have lower competitive attributes than more aggressive plants and animals from continental areas (Green, 2000). In New Zealand's case, flora have often not developed characteristics to withstand pressures such as the introduction of grazing animals.

Until humans settled here about 1,000 years ago New Zealand had been isolated for many tens of millions of years from Gondwanaland. That isolation resulted in a unique assemblage of species, 90% of which are found nowhere else in the world. As pointed out by Sutherland (2000), the thousands of species endemic to New Zealand can be compared with Great Britain, where there are just two endemic species: one plant and one animal.

As the following figures point out (Sutherland, 2000; MfE, 1997), our history of biodiversity loss caused largely by pressures on indigenous flora and fauna as a result of human settlement, indicates a significant impact in a relatively short period:

- 600 years after the arrival of the first human settlement in New Zealand, 33% of indigenous forests had gone. By 1990 (about 1,000 years after first settlement), 66% of indigenous forests had been cleared (for urban settlement and agriculture).
- New Zealand has gained 31 species of exotic mammals, 24 of which have become major pests (eg possums, rabbits, stoats, deer).
- 200 species of invasive weeds have been introduced.

- Since the early 1800s, on average, one new plant species has become naturalised in the Auckland region every 80 days.
- In the past 700 to 800 years nearly one-third of our endemic land-based birds and 18% of endemic seabirds have become extinct, and 1,000 of our known animal, plant and fungi species today are threatened, if not endangered.

Alien species threaten a third of our protected forests (1.8 million hectares) and put pressure on smaller reserves and individual species. In the marine environment, the amount and rate of marine biodiversity loss is largely unknown.

Island bird species, in particular, have been woefully unprepared for the arrival of predators such as cats, rats, stoats and ferrets. Thanks to human migration and commerce, the number of alien species that have established in new ranges has increased significantly in the past 500 years, and especially in the past 200 years. With the increasing trends in global trade, the pressures on indigenous flora and fauna from exotic organisms over the next 20 years could be even greater.

The State of New Zealand's Environment (MfE, 1997) identified the introduction of pests and weeds that prey on native species, compete with them or damage their habitat as one of the main threats to most species. In terms of environmental damage, the extent of the pressures from introduced pests and weeds have already been well covered in other reports (New Zealand Government, 2000; MfE, 1997; NZCA, 1999). These reports highlight the need for an effective biosecurity system to protect and maintain our remaining indigenous biodiversity and ecosystem health.

Six years of international research into global change (Global Change and Terrestrial Ecosystems Project of the International Geosphere – Biosphere Programme) came to the consensus that the main cause of future biodiversity loss at a global scale will be land change, mainly from habitat loss and fragmentation of landscapes. The next most important global factor identified was invasion by alien species. Scientists expect alien invasives to have even greater impacts in the future, given (1) the globalisation of economies and, hence, the greater movements of people and materials; and (2) the susceptibility of disturbed ecosystems to invasive species (Green, 2000).

So, the combination of human settlement and the introduction of organisms that have subsequently become pests, has resulted in significant modification of ecosystems, loss of species and high costs of ongoing pest and weed control. As a result there is a need for a biosecurity system that will prevent, or at least slow down the rate of, further decline in biodiversity and ecological damage.

2.4 The hitchhikers, the smugglers, the oblivious and the careless

Pathways that offer a passage for pests and diseases into New Zealand are as important to consider as the impacts of the pests and diseases themselves. Apart from 'natural' pathways such as wind, ocean currents and migrating birds, there are four human-generated pathways worth examining.

2.4.1 The hitchhikers

This term is used to describe organisms that inadvertently, or through some oversight or chance, find their way to New Zealand by being transported on imported goods or containers, in luggage or equipment, or in or on aircraft or ships (eg ballast water) transporting the goods. Examples include Asian gypsy moth egg masses carried by imported used vehicles from Japan, snakes carried inside shipping containers, mosquito larvae carried in water lying inside second-hand tyres, forest pests in timber shipments and dunnage, fungi and nematodes in soil stuck to the bottom of containers, and fouling of ships' hulls.

Pre-shipment inspection, cleaning and treatment can reduce the risk of hitchhikers, but additional inspection at the port of entry or destination of the goods may also be necessary (eg in the case of containerised goods) to provide additional assurance, particularly if the goods come from a high-risk country.

Since unintentional introductions arrive in association with traded commodities or visitors, new trading initiatives, and visitor embarkation points and travel routes, create new opportunities and new pathways for alien and invasive species.

2.4.2 The smugglers

In the context of this report, smuggling is the illegal importation of goods that present a biosecurity risk. In other words, the deliberate attempt to import or carry an organism (or a product containing one) into New Zealand contrary to New Zealand's Biosecurity Act or other relevant legislation (eg the HSNO Act). At its most serious level, smuggling could involve 'bio-terrorism' – a deliberate attempt to undermine New Zealand's agriculture-based economy – which is more likely to target primary production systems rather than indigenous ecosystems, but which could be disastrous for our economy and environment. Green (2000, p 17) discusses this aspect in more detail. MAF have been involved with other agencies in monitoring international developments in this type of threat.

Experience from the illegal introduction of rabbit haemorrhagic disease (RHD) in mid-1997 shows how difficult it is for the biosecurity system to deal with covert behaviour, deliberate flouting of the law, and undetectable microbes. Another example is the Varroa mite. Circumstances suggest that the parasitic bee mite may have arrived via a queen bee smuggled into New Zealand. These examples indicate the extent to which compliance with biosecurity requirements relies heavily on trust and the public's awareness of the importance of biosecurity to New Zealand.

A growing concern for the biosecurity system is the evidence from MAF Quarantine Service that the smuggling of plant seeds or viable plant fragments is taking place. Plant material has been detected by x-ray equipment and detector dogs during routine screening of overseas mail packages.

2.4.3 The oblivious

Many visitors to New Zealand come from countries where the concept of 'invasive' plants and animals is unknown and it is common practice to travel with food or even animals. Green (2000) mentions examples of attempts by airline passengers to bring in high-risk material, including one case of a passenger who brought in a live giant African snail intended for a gourmet meal. Other examples include unsolicited mail containing seeds received by one Crown research institute,[12] and seeds of red bottlebrush (a weed) distributed as part of an Australian wine promotion in New Zealand (an 'internal' biosecurity issue for regional councils).

This category also includes visitors or returning residents who are asymptomatic or otherwise unaware they are infected with an environment-related infection such as tuberculosis or giardiasis, which may be carried into the country and easily spread. Most tourists travel on certain well-defined tourist routes, including national parks. Returning residents may disperse anywhere in New Zealand.

2.4.4 The careless

Biosecurity carelessness can lead to long-term, irreversible and costly impacts. This category includes those, such as returning residents, who are not smugglers and are aware of New Zealand's biosecurity requirements but show careless disregard for them. An example is the person who attempts to return to New Zealand with fruit that may contain fruit fly larvae.

Green (2000) draws attention to a study in December 1981 in which 45 tents belonging to air passengers were thoroughly examined. Live insects were found in six tents (13%) along with plant and animal debris. It was concluded that this posed 'a major risk', especially given the likelihood that travelling owners of tents will camp in national parks or other indigenous forest areas. Another study showed there was a high probability of visitors bringing pathogenic fungi of threat to forests and agricultural crops into New Zealand on their clothing.

[12] *Dr Oliver Sutherland, Landcare Research, pers comm.*

2.5 Biosecurity – a common interest and a shared responsibility

2.5.1 The importance of biosecurity

Biosecurity is in the interests of all New Zealanders and those who visit New Zealand to enjoy its natural features. Without some form of biosecurity, invasive and harmful organisms could have serious impacts on our economy, environment, culture and health. We have identified in section 2.3 the impact that colonisation has had on New Zealand's indigenous species.

Species within ecosystems are significant not only in terms of their intrinsic conservation and biodiversity values, but also because they contribute to biological systems that support 'services' such as the purification of water, nutrient cycling and waste decomposition.

New Zealand's indigenous biological assets are also important to:

- the tourism industry, which relies on the provision of natural experiences through the integrity of unique biological landscapes and the lack of threatening species
- industries based on native species and their quality (eg green-lipped mussel farming)
- the aesthetic values from landscapes, plants and birds, which are important to the majority of New Zealanders living in urban environments (MoRST, 1998)
- the cultural, spiritual and other values of tangata whenua.

Exotic species introduced into New Zealand, which are important to the functioning of the country's economy and are now an integral part of our environment, include:

- animals such as sheep, cattle and deer, and plants such as ryegrass and white clover
- fruit species such as apples, kiwifruit, and various pip and berry fruit
- plantation forests consisting of *Pinus radiata*, Douglas fir, eucalyptus species and other exotics
- Pacific oysters.

2.5.2 The requirements for biosecurity management

Biosecurity management faces some inherent resource difficulties such as:

- technical limitations of border detection systems
- limited staff resources
- increasing volumes of goods and passengers arriving in New Zealand
- the high and unpredictable costs of eradicating or controlling pests and diseases that arrive undetected.

But effective biosecurity is not simply achieved by setting up rigid and costly government structures, regulations, penalties and procedures. Nor does increased funding necessarily achieve a reduction in biosecurity risk. The law of diminishing returns applies to biosecurity risk management, such that the cost of each successive unit reduction in biosecurity risk is likely to rise, and becomes very large the closer the risk approaches zero (NZIER, 2000, p 4).

Effective biosecurity requires a partnership approach involving central and local government, industry, tangata whenua, research organisations and non-government organisations in biosecurity policy development, and engaging the general public in the management of biosecurity risks.

In the context of biosecurity, partnership is more than just consultation. It involves a commitment by both the public and private sectors to actions such as:

- accepting individual and collective responsibilities for biosecurity
- participating in biosecurity decision-making
- collaborating and sharing information, expertise and other resources to achieve the common goal of an effective biosecurity system
- contributing to biosecurity research that will improve our understanding of biosecurity risks and how they can be avoided or reduced
- increasing awareness among the New Zealand public, visitors to New Zealand and our trading partners about the particular significance of biosecurity to New Zealand.

Creating opportunities for better co-ordination and participation of all the biosecurity agencies was one of the primary reasons for establishing the Biosecurity Council. The Council, however, is not the complete solution to 'partnership' in biosecurity. It is where the concept starts and grows.

The Government's commitment to developing a Biosecurity Strategy needs to incorporate the concept of shared responsibility among all interested parties and promote greater awareness about the importance of biosecurity to New Zealand's economy, environment, culture and public health.

2.5.3 Biosecurity risk management principles

Managing biosecurity risks involves taking into account a very wide range of interests and stakeholders, but also runs the risk of being 'captured' by some of the more dominant ones (such as trade). Conflict between various interest groups can be avoided if an agreed set of principles can be established in consultation with the parties. An opportunity exists, with the Government's proposal to develop a Biosecurity Strategy (see section 8), to incorporate a broad set of principles applicable across all sectors, based on shared responsibility, and covering:

- pre-border measures to reduce the threat of entry
- risk-based border controls
- monitoring and surveillance for the early detection of incursion and spread of harmful organisms
- emergency response strategies to contain, control or eradicate interceptions and incursions
- ongoing pest or disease management
- resource and information-sharing
- public education strategies to improve awareness of the risks.

Examples of some principles that could be considered include the following:

- Biosecurity involves *avoiding* unnecessary risks, *reducing* high risks and *managing* residual risks.
- Risk exacerbators and beneficiaries of the biosecurity system should contribute towards the costs of providing biosecurity, depending on the costs they impose on the system and the benefits they receive from it.
- Public authorities are primarily responsible for protecting the public interest in biosecurity, such as the protection of indigenous flora and fauna, biodiversity and public health.
- Mitigation, preparedness and response (key elements of biosecurity emergency management) require commitment and effective involvement by all sectors, and co-ordination and co-operation among the agencies involved.
- In a biosecurity emergency response, one agency should have the lead role. The responsible agency will depend on the circumstances, such as the effect of the incursion and what is 'at risk'.
- Response to an incursion needs to be appropriate to the nature of the risk and the scale of the potential consequences.

3.1 Responsibilities and outcomes

3.1.1 Responsibilities

The Minister for Biosecurity is the responsible Minister under the Biosecurity Act and has overall responsibility for:

- providing for the co-ordinated implementation of the Act
- recording and co-ordinating reports of suspected new organisms
- managing appropriate responses to such reports (s 8 Biosecurity Act 1993).

Other Ministers also have functions under the Act, including:

- the development of national pest management strategies (s 10)
- taking action in relation to biosecurity emergencies (s 11).

3.1.2 Outcomes

In contrast to other areas, such as national security and emergency management, where the Government has established outcomes or goals for its agencies, the Government's biosecurity outcomes remain unclear. Because of this and the strong influence of MAF in biosecurity, most of the emphasis so far has been on outputs to protect primary products from pests and diseases, and facilitation of export market access for such products.

In the case of national security, the Government has set out five National Security Outcomes that indicate New Zealand's security interests (New Zealand Government, 2000b). While these outcomes are directed mainly to the New Zealand Defence Force, Ministry of Defence and Ministry of Foreign Affairs and Trade, the first three are also relevant to New Zealand's biosecurity interests:

- *A secure New Zealand including its people, land, territorial waters, EEZ, natural resources and critical infrastructure.*
- *A secure and stable environment in the South Pacific that is supportive of New Zealand's national interests and provides assistance to our Pacific neighbours.*
- *A strong relationship with Australia in pursuit of common security interests.*

Biosecurity also seeks to secure and protect our natural resources, and New Zealand, in common with its Pacific nations and Australian neighbours, is an island nation with similar trade links and a shared interest in protecting and maintaining a unique biodiversity.

New Zealand's indigenous biodiversity and ecosystem health would benefit from having explicit biosecurity outcomes, and the actions necessary to achieve them, based on the following hierarchy:

a) avoiding risks where possible

b) reducing risks that cannot be avoided

c) managing risks that cannot be avoided or reduced.

The necessary outcomes and actions would be based on criteria such as practical feasibility and the relative costs and benefits to the economy, environment and society.

Biosecurity risk avoidance and reduction can be achieved by promoting the concept of 'safe trade' in the context of 'free trade' (trade liberalisation), and through public and visitor awareness campaigns.

Biosecurity incorporates elements of national security and emergency management, and involves multiple agencies and a wide range of interests. It is important that the Government acknowledges the significance of these elements and clearly sets out the outcome(s) it expects from its biosecurity system.

3.2 Managing the risk – institutional arrangements and funding

Four central government agencies and all regional councils and unitary authorities have statutory responsibilities under the Biosecurity Act. The Minister for Biosecurity purchases services (under Votes: Biosecurity) from each of the central government agencies: Ministry of Agriculture and Forestry, Department of Conservation, Ministry of Fisheries and Ministry of Health.

3.2.1 Ministry of Agriculture and Forestry (MAF)

MAF has a pivotal role in biosecurity and receives about 95% of the funding in Votes: Biosecurity. There are a number of sections within MAF that have biosecurity functions:[13]

- MAF Policy is involved in strategic policy advice, including advice on the Biosecurity Act and any necessary legislative changes.
- MAF Biosecurity Authority has an operational policy and standard-setting role in relation to managing biosecurity risks to animal, plant and forest health. It also deals with animal welfare issues. Its responsibilities include analysing biosecurity risks, preparing import health standards, preparing border and transitional facility (eg quarantine or treatment facilities) standards, developing surveillance systems and standards, co-ordinating the activities of the biosecurity agencies, developing emergency response plans, contributing to international standards and agreements, and providing plant and animal export certification.
- MAF Quarantine Service provides the border inspection of vessels, aircraft, goods (including mail) and people entering New Zealand to detect and intercept unwanted organisms, in accordance with specifications set by MAF Biosecurity Authority. The Quarantine Service also undertakes border inspections on behalf of the other government departments with biosecurity responsibilities.
- Other parts of MAF operations include the National Centre for Disease Investigation and the National Plant Pest Reference Laboratory.

Strategic issues for MAF identified by the Government in its 2000/01 Estimates of Appropriations include:

- progressing the development of a Biosecurity Strategy incorporating the government's positions on acceptable levels of protection, import risk analysis, and generic incursion response policy
- co-ordinating biosecurity activities among government departments, to ensure the government's biosecurity policies are implemented effectively and efficiently.

Funding in 2000/01 for Output Class D6: 'Specific Disease and Pest Responses' specifically provides for responses to Dutch elm disease, subterranean termites, gumleaf skeletoniser, and painted apple moth.

[13] *Further information can be found on MAF's web site (http://www.maf.govt.nz).*

3.2.2 MAF Biosecurity Authority

MAF Biosecurity Authority was established in July 1999 to provide greater focus for, and co-ordination of, biosecurity. The Biosecurity Authority plays a pivotal role, both within MAF and among the other biosecurity agencies, in policy, technical and operational aspects of managing biosecurity risks.

MAF Biosecurity Authority describes its mission as being 'to protect New Zealand's unique biodiversity and facilitate exports by managing risks to plant and animal health and animal welfare' (MAFBA, 2000d). However, there is no evidence in MAF's recent annual reports or in the 2000/01 Estimates of Appropriations that funding has been or is allocated to MAF Biosecurity Authority for the protection of New Zealand's indigenous biodiversity.

In an August 2000 article (MAFBA, 2000e), the Minister for Biosecurity made reference to increased funding in the biosecurity area, some of which would be targeted at the assessment and management of risks to native flora and fauna. The Minister referred to the Government's allocation of an additional $500,000 to fund MAF Biosecurity Authority's regulatory functions, and $2.7 million to biosecurity initiatives stemming from *The New Zealand Biodiversity Strategy* (New Zealand Government, 2000a). In that article the Minister pointed out:

> *The new funding announced in the budget will also allow MAF Biosecurity to employ experts to consider risks to native flora and fauna. Risk analyses that support import health standards must assess the impact of exotic pests and diseases on both our productive sectors and the native plants and animals that are valued by New Zealanders.*

In a later article (MAFBA, 2000b), MAF Biosecurity Authority pointed out that additional staff[14] will be taken on to assess and manage risks to indigenous flora and fauna, and to deal with surveillance and response for exotic animals that are a risk to indigenous flora and fauna, but are not necessarily a threat to primary industries.

[14] *MAF advise that a staff member has recently been employed to deal with surveillance and response to exotic animals that are a risk to indigenous flora and fauna (MAF, comments to the PCE, 10/11/00).*

3.2.3 Department of Conservation (DoC)

DoC provides policy advice on biosecurity risks to indigenous flora and fauna and biodiversity. It also provides advice to other departments, such as MAF, in the preparation of import health standards, and comments on proposals to import or develop new organisms under the HSNO Act.

The Department's funding for biosecurity covers four output areas:

- *policy advice* – includes advice in relation to the introduction of unwanted organisms and the effects on native flora and fauna, pest management strategies, risk analysis and management, and systems for monitoring, surveillance and early detection of new pests in indigenous forests and other natural ecosystems
- *Crown pest/weed exacerbator costs* – includes 'Crown as exacerbator' contributions to the administration of regional pest management strategies
- *indigenous forest biosecurity protection* – includes monitoring the health of indigenous forests to detect unwanted organisms, and the provision of forest health diagnostic and advisory services
- *specific pest and disease responses* – includes the delivery of services associated with responses to exotic disease or pest incursions.

DoC is funded through Vote: Conservation, as part of its management of the conservation estate, to carry out:

- eradication or control of possums, goats and other animal pests to prevent forest canopy collapse, adverse habitat changes, and species loss, and to prevent the establishment of populations in new areas
- eradication, containment and management of invasive weeds that are, or are capable of, significantly affecting important natural areas, threatened species, or ecological processes.

A strategic issue for DoC, outlined in the Government's 2000/01 Estimates of Appropriations, is identifying and evaluating a list of unwanted organisms and developing management systems for those that pose the greatest risk to indigenous flora and fauna.

3.2.4 Ministry of Fisheries (MFish)

The responsibilities of MFish in the area of biosecurity include:

- providing policy advice on marine biosecurity, including advice on measures to prevent organisms arriving, detect organisms if they do arrive, respond to those incursions and manage pest species
- managing contracts for services delivered by other parties, including enforcement activities and scientific research
- monitoring compliance with New Zealand's marine biosecurity requirements
- providing advice on regulatory measures for marine biosecurity.

MFish administers ballast water management and has responsibility for exotic organism response and surveillance in the marine environment. MFish is currently considering the option of a national pest management strategy (NPMS) for the invasive seaweed *Undaria pinnatifida*. It has already promulgated an import health standard for ballast water (May 1998), which provides for controls on the discharge of ballast water in New Zealand ports.

A focus for MFish in 2000/01 and beyond (as outlined in the Estimates of Appropriations) will be on continuing towards building a system for protecting the marine environment from biosecurity threats, including improving compliance with New Zealand requirements, and reducing the risk from vectors, specifically ballast water and hull fouling. The Ministry is to continue to work with other departments to achieve biosecurity objectives, including ensuring that gaps in marine biosecurity are identified and strategies put in place to address them.

3.2.5 Ministry of Health (MoH)

The MoH provides the Minister for Biosecurity with policy advice and specific disease response in relation to biosecurity risks to people's health posed by pests and diseases. Recent major commitments of the Ministry have included reporting to the Minister for Biosecurity on the Napier mosquito (southern saltmarsh mosquito) eradication plan, the development of a discussion document on an NPMS[15] for exotic mosquitoes of public health significance, and running training programmes on surveillance of exotic mosquitoes and emergency management.

[15] *The MoH, with the agreement of the Minister, has discontinued work on the development of an NPMS for exotic mosquitoes, and instead is working towards providing stronger leadership to the health sector on the surveillance, control, exclusion and management of exotic mosquitoes.*

In recent years the Ministry has commissioned research into the potential for exotic mosquitoes to introduce and spread arboviral diseases (eg Ross River and dengue fevers) in New Zealand.

Operational activities, such as surveillance of and responses to interceptions of unwanted organisms of public health significance, are undertaken by public health services funded through Vote: Health.

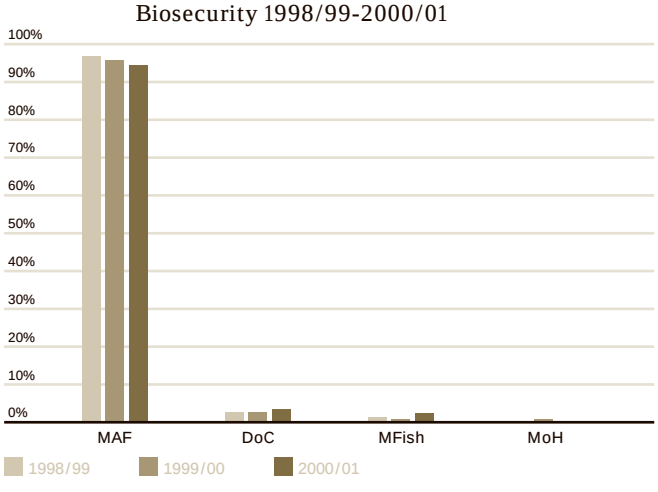
In 2000/01 the Ministry will continue phase two (eradication) of the response to the southern saltmarsh mosquito incursion in the Hawke's Bay region. At the time of writing the MoH was considering the most appropriate response to an incursion of southern saltmarsh mosquito found in the Gisborne region.

3.2.6 Funding

The allocation of funding in the Government's Estimates of Appropriations for the four central government agencies with biosecurity responsibilities (MAF, DoC, MFish and MoH), and the outputs purchased over the three years 1998/99, 1999/2000 and 2000/01, are shown in Figures 1 and 2.

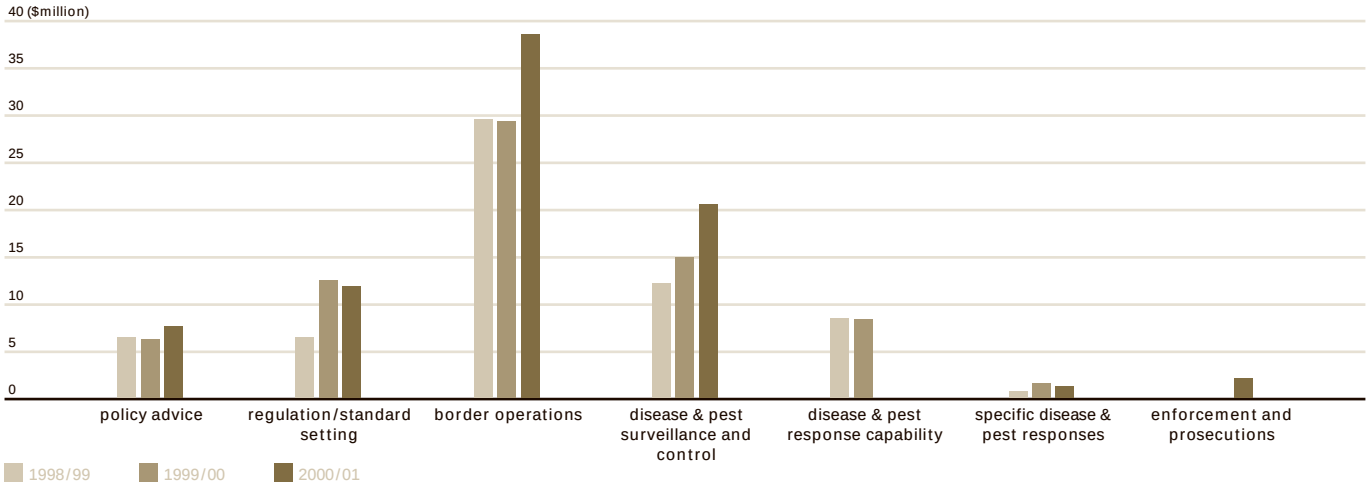
Funding through Votes: Biosecurity for all biosecurity agencies has increased from $82.935 million in 1998/99 to $103.458 million in 2000/01. Most of this funding (between about 94 and 96%) goes to MAF while DoC receives about 3%, and MFish and MoH less than 1% each.

Figure 1. Percentage allocation of votes: Biosecurity 1998/99-2000/01



Source: *The Estimates of Appropriations for the New Zealand Government for the years 1998/99, 1999/2000 and 2000/2001. New Zealand Government, Wellington.*

Figure 2. Funding for departmental biosecurity outputs between 1998/99 and 2000/01



Source: *The Estimates of Appropriations for the New Zealand Government for the years 1998/99, 1999/2000 and 2000/2001. New Zealand Government, Wellington.*

As indicated in Figure 2, border operations receive most of the funding (representing between 41 and 48% of the total biosecurity allocation), pest and disease surveillance comes next, followed by regulation and standard setting, disease and pest response capability, and policy advice. In the 2000/01 year 'disease and pest response capability' has been dropped as a separate output, while funding has increased in the categories of 'border control', 'disease and pest surveillance and control' and 'enforcement and prosecutions', indicating a realignment of output classes and perhaps an intention by the Government to get tougher on biosecurity breaches.

The lack of funding in 2000/01 for disease and pest response capability may be offset by the Government's commitment to spending an extra $2.7 million over the next five years to enhance New Zealand's biosecurity capability through the development of a Biosecurity Strategy and assessing biosecurity risks to indigenous flora and fauna. Under the same package, the Government is to spend an extra $9.8 million over the same period on marine biosecurity (New Zealand Government, 2000c) (see section 8).

The future resourcing and allocation of Votes: Biosecurity need to be regularly reviewed to ensure that biosecurity threats to indigenous flora and fauna, biodiversity and ecosystem health are adequately assessed on an ongoing basis, and that agencies' response capabilities are not diminished to the extent that eradication or management of pests and diseases are adversely affected.

3.2.7 Local authorities

The Biosecurity Act (s 13) empowers regional councils to undertake pest management functions. These include:

- carrying out monitoring and surveillance of pests, pest agents, and unwanted organisms in their regions
- providing for the assessment and management or eradication of pests in accordance with relevant pest management strategies
- introducing regional pest management strategies (RPMSs)
- implementing small-scale management programmes
- gathering information, keeping records and undertaking research.

During the course of this investigation, it has been suggested that regional councils, as part of their monitoring and surveillance functions, provide the point of contact and link between local communities and central government biosecurity agencies to promote the concept of partnership in the identification and detection of biosecurity breaches.

Regional councils (or any other persons) may prepare proposals for RPMSs. Part V of the Biosecurity Act sets out the process.

A typical biosecurity programme of a regional council has three main components:[16]

- *regional tuberculosis (Tb) control* – in which the council acts as as an agent of the Animal Health Board, undertaking the control of pests (eg possums and ferrets) which carry bovine Tb, for the purpose of reducing bovine Tb in the region to the Board's specifications and budget
- *regional animal pest management* – to identify and manage significant pests for the region, in accordance with the RPMS, to improve the regional environment
- *regional plant pest management* – to identify and manage significant weeds and other plant pests, in accordance with the RPMS, to improve the regional environment.

The contents of a RPMS, specified in section 80A of the Biosecurity Act, include:

- the pests to be managed or eradicated
- the objectives of the strategy
- the strategy rules
- the sources of funding for the strategy.

Most regional councils are now at the stage of reviewing their first RPMSs under the Biosecurity Act. The Act (s 88) requires strategies to be reviewed if they have been in force for five or more years.

Regional councils spend over $40 million per year on pest management, of which roughly $20 million is funded from central government (eg through the Animal Health Board) (NZCA, 1999).

Territorial authorities are empowered under s 14 of the Biosecurity Act to:

- take action under Part V (Pest Management) of the Biosecurity Act
- act as a management agency under a pest management strategy
- take any action provided for or required by any pest management strategy
- contribute towards the cost of implementing a national pest management strategy to the extent that the strategy provides for such contributions to be made, and levy rates for that purpose
- gather information, keep records and undertake research.

The Act (s 13(2)) empowers regional councils to have all the above powers of a territorial authority.

[16] *See, for example, Environment Waikato, 1999, pp 67-76.*

3.2.8 Pest management strategy advisory committee

This is a ministerial advisory body mainly representing regional councils' biosecurity interests. It advises the Minister for Biosecurity on pest management strategies under the Biosecurity Act and pest management matters in general.

3.2.9 Chief technical officers

The Biosecurity Act places a significant degree of decision-making power in the hands of chief technical officers (CTOs). The Act (s 101(1)) requires the Director-General of Agriculture and Forestry to appoint CTOs for the purposes of the Act. Other biosecurity agencies at central government *may* appoint CTOs (s 101(2)), and in fact all have done so.

Functions of a CTO include:

a) determining whether an organism is an 'unwanted organism' (s 2)

b) making recommendations on the issue of import health standards for the effective management of risks associated with the importation of risk goods (s 22)

c) receiving reports of notifiable organisms (s 46)

d) having the power to require information relating to organisms (s 48)

e) intervening in the management or operation of transitional or containment facilities to ensure compliance with conditions (s 126)

f) giving directions as to the disposal or treatment of seized goods (s 116) and the destruction of imported goods (s 127)

g) declaring controlled areas and placing restrictions on movement into, within or out of those areas (s 131).

Functions (a) and (b) above are important in terms of preventing organisms and controlling risk goods entering New Zealand.

The powers of CTOs other than those appointed by the Director-General of Agriculture and Forestry are restricted by section 101(3) to exclude certain powers under Part VI of the Biosecurity Act, such as (e) and (f) above.

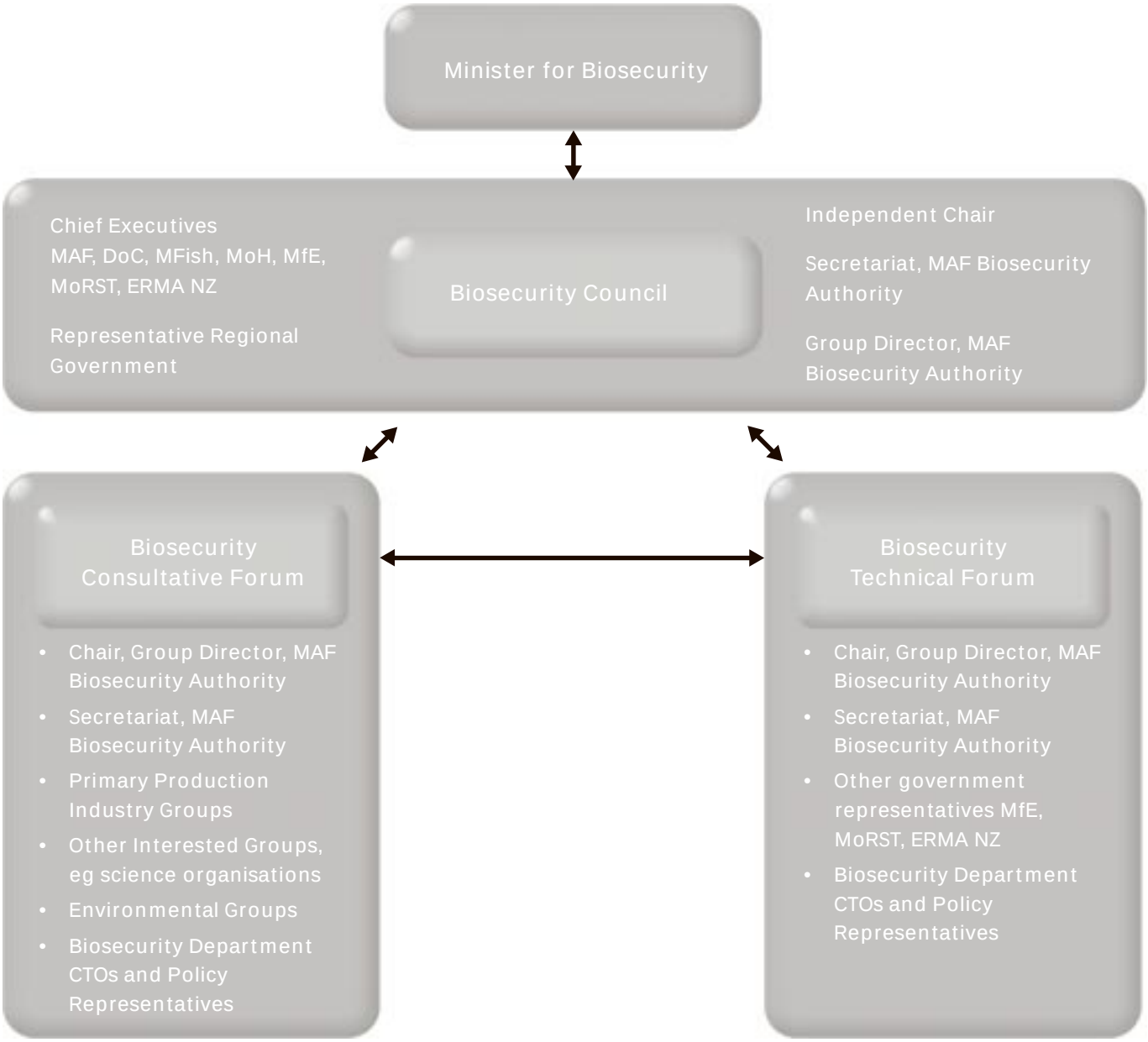
Although CTOs are required under the Act to have regard to certain factors and to consult in certain circumstances, ultimately these statutory officials retain the power to make biosecurity decisions (Matheson, 2000).

3.3 The Biosecurity Council

The Biosecurity Council is a forum for the co-ordination of strategic policy advice on biosecurity matters. It is a non-statutory body, established in 1997 by the then Minister for Biosecurity to provide the Minister with co-ordinated and consistent advice on biosecurity policy and implementation across central government agencies with statutory responsibilities for biosecurity. The Council has an independent chair and comprises the chief executives (or their delegated representatives) of each of the four central government agencies with responsibilities under the Biosecurity Act (MAF, DoC, MFish and the MoH), together with the chief executives of the Ministry for the Environment (MfE), the Ministry of Research Science and Technology (MoRST), the Environmental Risk Management Authority (ERMA NZ), a representative of regional councils and the Group Director of MAF Biosecurity Authority.

Figure 3 shows the current structure of the Council and the lines of responsibility, including the forums that provide the Council with technical advice and stakeholder views.

Figure 3. Biosecurity Council



The Biosecurity Technical Forum includes, among others, the CTOs from each of the biosecurity agencies. Its function is to discuss policy, technical and operational matters before they are brought to the Biosecurity Council for consideration. The Biosecurity Consultative Forum provides an opportunity for other stakeholders, such as the private sector, non-governmental organisations and science providers, to contribute their views.

The Biosecurity Council currently advises the Minister on such matters as:[17]

- priorities for purchasing biosecurity services (including research)
- appropriate framework(s), methodologies and procedures for risk assessment, risk management and risk communications to ensure consistency in approach across departments, taking account of the approach adopted by Crown entities with responsibilities for managing biosecurity-related risks
- co-ordination of biosecurity-related research (including Public Good Science Fund and departmental operational research), and the need for a National Science Strategy for Biosecurity
- protocols for cross-agency co-operation (including funding bids)
- appropriate location and structure of biosecurity-related border inspection work (and the relationship to Customs)
- 'investigations' related to biosecurity initiated by the Minister
- responsibility for newly identified risks
- departmental responsibility for new pest incursions
- a strategic overview of an information and education strategy for biosecurity surveillance and awareness raising
- legislative or institutional barriers to biosecurity management and how these may be overcome
- departmental capacity and capability to respond to biosecurity risks, and how these systems may be enhanced and adapted for new and emerging risks.

Issues the Biosecurity Council has addressed since it was established include:

- promotion of, and initial work on, the development of a biosecurity strategy for New Zealand (the latter includes work on the process for its development)
- an outline of areas for biosecurity-related research
- policy statements on:
  - the development of national pest management strategies by departments
  - interdepartmental consultation on risk analysis and import health standard development
  - unwanted organisms
- a review of the release of RCD (rabbit calicivirus disease) in New Zealand.

Issues currently being, or about to be, addressed by the Biosecurity Council include:

- New Zealand's 'appropriate level of protection' against biosecurity risks
- the application of precaution in managing biosecurity risks
- a policy statement on conducting and applying import risk analyses
- a policy statement on exotic pest and disease incursion responses.

3.3.1 A case for revising the structure of the Biosecurity Council

Biosecurity covers a wide range of issues and interests, including:

- public and private sector interests in biosecurity protection
- prevention, detection, interception, eradication and control of pests, diseases and other unwanted organisms
- assessing and managing potential threats to the environment, the economy, and people's health and wellbeing
- international, national, regional and local biosecurity risk management requirements
- potential short- to long-term, cumulative, synergistic and delayed effects of unwanted organisms
- different types and scales of impacts in different parts of the country
- response to, and ongoing management of, emergency situations (incursions)
- public awareness and education about the importance of biosecurity to New Zealand
- monitoring biosecurity threats and impacts on the status of animal, plant and forest health, ecosystem health and biodiversity (in terrestrial, freshwater and marine environments), and public health.

[17] *See http://www.maf.govt.nz/Biocouncil/publications/tor.htm.*

Under current arrangements each biosecurity agency is responsible for ensuring the delivery of its biosecurity outputs together with its other core functions. For all the agencies except MAF, biosecurity is a minor but important function (see earlier section on funding). There are also other non-government stakeholders who have a range of interests in New Zealand maintaining an effective biosecurity system. Some of those interests are financial, while others are environmental, cultural, social or driven by non-monetary values. Biosecurity encompasses so many interests and responsibilities that some means of co-ordination is necessary to ensure that all parts of the system operate in a cohesive, consistent and integrated manner to be effective.

A common criticism that came through during consultation with stakeholders was that the Biosecurity Council lacks a strategic approach to biosecurity: it tends to focus on operational matters affecting individual departments represented on the Council, and does not examine strategic risks or priorities across the whole spectrum of biosecurity interests. The Council was also criticised for not having representation from Maori, the private sector, Crown research institutes and other stakeholders.

Another question raised during consultation was whether the Council should be set up under statute for it to be more effective. However, there is no evidence to suggest that the lack of a statutory basis has any influence on what the Biosecurity Council was set up to do. A co-ordinating body to advise the Minister does not require a statute to exist or to be effective. If the Biosecurity Council were a statutory body, taking into account its current membership, its functions may overlap with those of the individual biosecurity agencies represented on it. The current set-up, based on a Ministerial directive, allows some flexibility in the structure, membership and terms of reference of the Council to enable it to evolve and adapt as circumstances require – something that would be difficult to do if its functions were prescribed by legislation.

The effectiveness of the Biosecurity Council as an advisory body can be assessed by its ability to assist the Minister ensure that biosecurity agencies:

- are adequately resourced to carry out their functions
- contribute to the Government's biosecurity outcomes
- adhere to an agreed set of biosecurity principles
- fulfil their statutory functions under the Biosecurity Act
- develop biosecurity strategies to promote safe trade and target high-risk goods and pathways
- protect 'at risk' natural resources, indigenous flora and fauna, people, primary production systems and exports
- develop protocols to make effective use of and share resources, information and expertise among the agencies, private sector, science providers, tangata whenua and others
- establish and use appropriate frameworks and methodologies for risk assessment, risk management and risk communication
- maintain capacity and capability to analyse biosecurity risks and respond in a timely and effective manner to biosecurity emergencies
- contribute to increasing public awareness about biosecurity risks
- undertake well-targeted research, monitoring and surveillance of existing and emerging biosecurity risks.

The question then becomes: is the current Biosecurity Council structure and membership appropriate for advising the Minister on the *effectiveness* or otherwise of the biosecurity system and, if not, what needs to change to enable it to do so?

With reference to the Council's terms of reference, and taking into account the indicators of effectiveness outlined above, a Ministerial advisory body consisting of the chief executives of the departments, which constitute the administrative side of the biosecurity system, is an important forum for co-ordinating strategies, setting priorities and committing resources to achieve biosecurity outcomes; and clarifying accountabilities and responsibilities, particularly in relation to biosecurity issues that may involve two or more agencies.

However, a Council consisting mainly of chief executives may not be the most appropriate source of advice to the Minister on the effectiveness of a system for which they have significant policy and management responsibilities. Those parties who have an interest in or are affected by it may be better placed to judge the effectiveness of the biosecurity system.

In order to maintain the co-ordination between biosecurity agencies, ensure that the best technical advice is available, and that the system is effective in achieving biosecurity and biodiversity outcomes, the Biosecurity Council and the two forums that advise it need to have clear roles and responsibilities.

3.3.2 Options for revising the structure of the Biosecurity Council and its forums

One option is to revise the terms of reference of, and representation on, the Biosecurity Council, the Biosecurity Consultative Forum and the Biosecurity Technical Forum to ensure that the Minister for Biosecurity receives the most appropriate advice on all aspects of biosecurity – from technical and effectiveness issues through to consultation and co-ordination of effort by the relevant agencies.

The main changes suggested here are to each of the forums – the Biosecurity Consultative Forum (BCF) and the Biosecurity Technical Forum (BTF), and their links to the Biosecurity Council, as indicated in Figure 4.

Representation on the BCF would be widened to include tangata whenua, port companies, importers, exporters and carriers. It would also include local government, which has a key role to play in raising public awareness about biosecurity and promoting vigilance as part of local government's biosecurity monitoring role. The BCF would have the prime responsibility for advising on the effectiveness of the biosecurity system, as it would consist mainly of the sectors who have no direct control of the system but who are directly affected by it. To avoid any single interest dominating the views of this forum, a system of 'rotating' the chair, or an 'independent' chair would be appropriate.

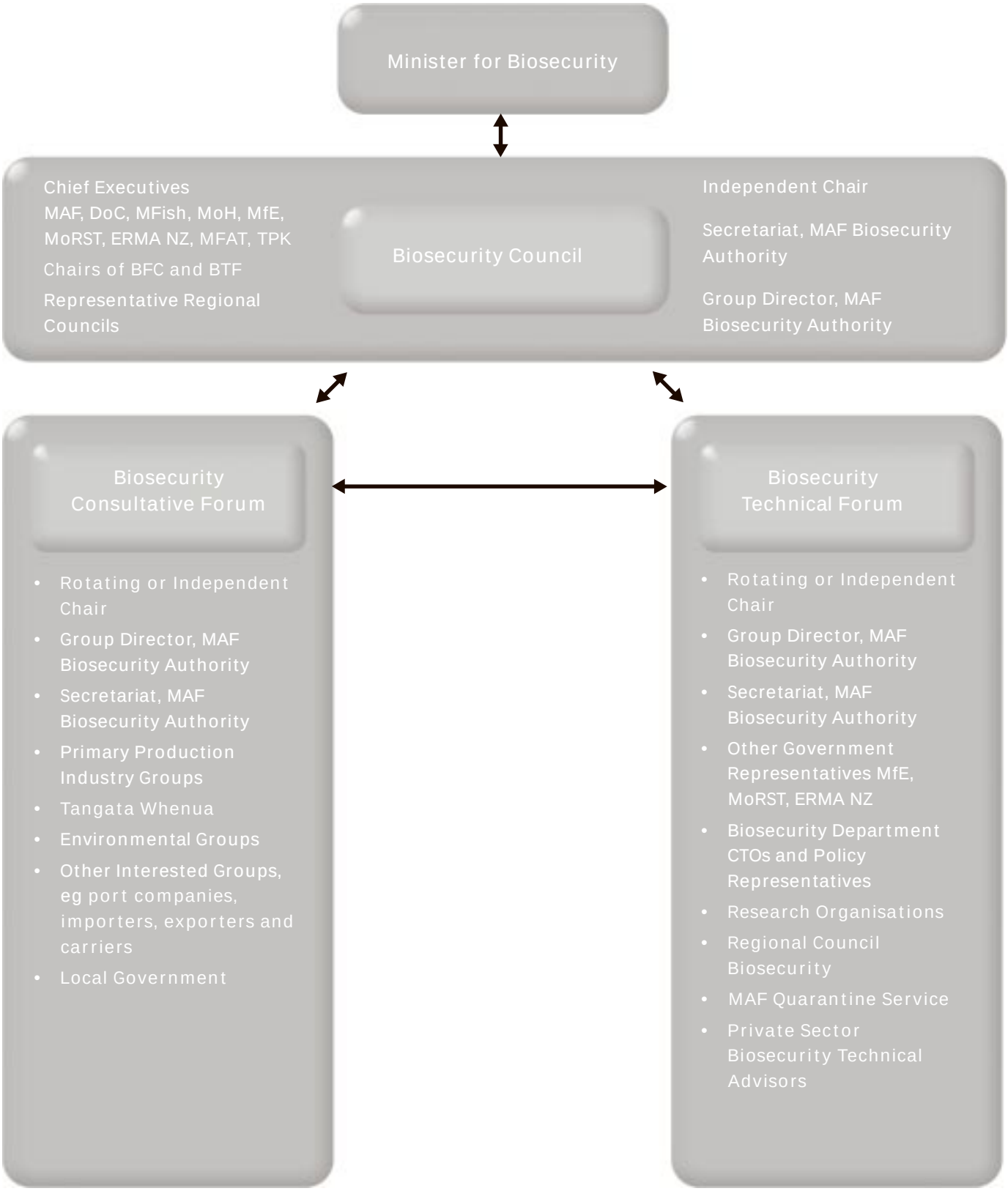
The BTF is the principal source of technical advice to the Biosecurity Council and the Minister, and needs to be able to draw on the best possible sources of technical information. It therefore needs to extend its membership to include representatives from relevant science/research organisations, regional councils' biosecurity advisors, MAF Quarantine Service (border control) and private sector biosecurity technical sources. The outcome of such changes would be an improved system of integrating research and information on biosecurity aimed at identifying priorities. The BTF may also benefit from having a 'rotating' or 'independent' chair to ensure that all technical perspectives are considered.

The choice between a 'rotating' or 'independent' chair will depend, among other things, on the need for continuity and balance.

The only changes suggested to the structure of the Biosecurity Council would be the addition of two departments that need to be involved in co-ordinating biosecurity – the Ministry of Foreign Affairs and Trade (MFAT) (with regard to international issues) and Te Puni Kokiri (TPK) (with regard to the Crown's obligations under the Treaty of Waitangi). The Biosecurity Council would be obliged to consider, and refer on to the Minister and appropriate biosecurity agencies, effectiveness or technical issues raised by the BCF and BTF. To facilitate this link, it is suggested that the chairs of the BCF and BTF should also be members of the Biosecurity Council. The BCF and BTF should also be able to take their concerns and advice directly to the Minister on matters that they consider are not being adequately addressed by the Biosecurity Council.

Figure 4. A Revised Biosecurity Council

(changes to the existing structure are highlighted in bold)



3.4 Legislation

The Biosecurity Act 1993 is the main statute governing the management of biosecurity risks and the control or eradication of pests, diseases and unwanted organisms (see Appendix A). Unlike other legislation of the same era, which deals with the (intended) introduction of new organisms (the HSNO Act) and the management of natural resources (Resource Management Act), the Biosecurity Act lacks:

- an over-arching purpose statement and set of principles to guide decision-makers
- reference to the Treaty of Waitangi and associated obligations
- a general duty to avoid, remedy or mitigate adverse effects arising from the introduction of an unwanted organism as a result of the importation of risk goods
- a requirement on any particular agency to take action in relation to the presence of a harmful organism.

The lack of 'requiring' provisions and the fact that an organism is not considered to be a 'pest' until it is defined as one in a pest management strategy, contrasts with other legislation such as the Resource Management Act, in which specific responsibilities for managing the effects of particular activities are assigned to each agency with powers under the Act. The lack of clear responsibilities for responding to potential pests could result in a harmful organism remaining unmanaged (Sinner and Gibbs, 1998 b).

Sinner and Gibbs in their analysis of the Biosecurity Act note that each aspect of the Biosecurity Act that involves risk management contains its own set of slightly different criteria for analysing risks. Some refer to 'the economy, human health and the environment' (s 7A), while others refer to 'the economy, people and the environment' (s 22), 'the economy and the environment' (s 144), or simply 'adverse and unintended effects' (s 100). In some cases only the costs or potential adverse effects of an activity require consideration (s 22, s 100), whereas in others a cost/benefit approach is required explicitly (pest management strategies) or implicitly through reference to actions being 'in the public interest' (s 7A, s 144). The provisions for preparing pest management strategies provide a much greater level of guidance of the types of risks to be considered than the provisions relating to border control activities.

Sinner and Gibbs also point out that while there was some criticism among biosecurity agencies about a lack of guidance for making decisions and determining an acceptable level of risk, others questioned whether legislative principles and criteria have any value, particularly in relation to the type of unplanned events the Biosecurity Act is designed to deal with.

Regional council representatives have expressed their concerns about the Biosecurity Act during the course of this investigation. They questioned whether consideration had been given to the outcomes expected, and how best to achieve them, before the legislative framework was developed. They felt in need of strong justification before committing ratepayer funds to biosecurity (some felt that the 'empowering' provisions of the Biosecurity Act was not sufficient – it was discretionary, unlike the RMA, which places clear responsibilities, and hence a financial commitment, on the councils. Regional councils were also concerned about their liabilities under the Act, which made some of them reluctant to take urgent action in the event of an emergency.

In a speech to the New Zealand Institute of Agricultural Science, the former Minister of Biosecurity, the Rt Hon Simon Upton, was critical of the lack of focus on outcomes and the influence that some agencies had on the development of the Biosecurity Act (Upton, 2000):

> *What started, sensibly enough, as an overhaul of a raft of out-of-date statutes like the Animals Act and a widening of their scope to securing the border against all bio-invaders, became one battle ground in a much wider upheaval concerning the role of the state and, in particular, the extent to which biosecurity services should be funded by the government or by those who benefited from them...*

The fault lies in a number of quarters. I don't believe MAF's legal capabilities have been revealed in a good light. But alongside the incomprehension of the State Services Commission (in overseeing endless re-structurings of the agency) and the fiscal myopia of the Treasury in seeking to make it extremely difficult ever to use the powers available under the [Biosecurity] Act, MAF's shortcomings are at least understandable. We have an Act – and an operational mindset – that gives little space to overall outcomes and vast attention to the apportionment of costs should anyone ever battle through the undergrowth long enough to be able to impose any.

There is a need to clarify the outcomes expected from the Biosecurity Act and how it is implemented, then to determine whether the Act (or any part of it) needs to be reviewed to ensure that it can deliver those outcomes.

3.5 Risk management – managing the threats and the threatened

MAF Biosecurity Authority has developed a good reputation in the field of biosecurity risk management among our trading partners and various international organisations. The focus of the Biosecurity Authority's risk analysis has been in relation to animal, plant and forest health, and animal welfare.
The Authority has not had the expertise to comment on risks to indigenous flora and fauna, biodiversity or ecosystem health. It relies on DoC, through the consultation process, to assess such risks. Most of the contact with DoC has been in relation to animal biosecurity. Although DoC has skills in assessing risks to indigenous flora and fauna, biosecurity remains a relatively small part of its overall responsibilities and it is poorly resourced compared to MAF (see section 3.2.6).

To meet the Government's biodiversity and biosecurity expectations (see section 8), MAF Biosecurity Authority intends to employ additional staff to assess and manage biosecurity risks to indigenous flora and fauna, and is in the process of preparing a memorandum of understanding with DoC. It is important that arrangements between MAF and DoC, in relation to biosecurity risks to indigenous flora and fauna, particularly native forests and plants, are such that a capacity to assess such risks is maintained and that any gaps or overlaps in skills are avoided.

3.5.1 Animal and plant risks

The general approach to animal and plant imports under the Biosecurity Act 1993 is that they are all prohibited entry into New Zealand from a supply country unless an import health standard has been issued. Import health standards are developed on a commodity basis (eg for a particular plant a separate import health standard is required for fruit, cuttings, whole plants) and apply to all pathways (eg commercial imports, mail, passenger luggage) (MAFBA, 2000a).

A major difference between animal and plant risks is that there is a much wider variety of plants and plant diseases to manage compared to animals. Since the 1960s the number of invasive weeds establishing in New Zealand has increased to about eight species per year (Atkinson and Cameron, 1993, in Green, 2000) – a far higher rate than the establishment rate of new animal pests. Green also points out that in the Auckland region over 615 alien plant species are now naturalised, possibly the highest figure for any city in the world, and four new species establish (usually out of gardens) in the region every year. The dominant source of weeds is from species that were deliberately introduced to New Zealand.

ERMA deals, among other things, with applications to introduce new organisms into New Zealand. The compliance costs and complexities of the HSNO Act process for approval to introduce new plant material, compared to the costs and process under the previous Plants Act the HSNO Act replaced and the lack of awareness of the new requirements, are believed to be some of the reasons behind the fall-off of such applications to ERMA. There is already evidence that this is adding to pressures on the biosecurity system. For example, mail containing plant material is frequently intercepted at Auckland International Mail Centre. DoC has expressed concern at the ease with which on-line shoppers can purchase plants and seeds from overseas sources via Internet catalogues. If some invasive species or seeds manage to get through the detection system, the consequences could be devastating for native plants and even livestock (eg Mexican feathergrass).

Green (2000) explores this issue further and outlines the example of Agriculture Western Australia, which is one of the few agencies that provide a free assessment of the weediness of any species not currently listed in either their permitted or prohibited lists.

ERMA, MAF Biosecurity Authority and DoC need jointly to examine options for encouraging importers of plant species or seeds to have them assessed for their weediness, invasiveness and other potential biosecurity impacts.

3.5.2 Risks to the marine environment

As Green (2000, p 20) has pointed out, island nations like New Zealand have unique marine as well as terrestrial ecosystem features. They tend to have more unique or endemic species than continental coastal areas and are often vulnerable to invasives.

The most significant pathways for invasive species to enter our territorial waters is via ships' ballast water discharges or hull fouling. New trade routes have increased the number of foreign marine species from Japan, other parts of the North Pacific and Asia that have established in our waters.

We are largely ignorant of the number of accidental marine introductions and their impacts in New Zealand waters. Surveillance has been poor due to low levels of funding and priority being given to terrestrial biosecurity. The monitoring that has been carried out has shown a significant degradation of our coastal marine ecosystems in our major ports and harbours where the bulk of alien species are most likely to arrive (Green, 2000).

The consequences for the economy and the environment are serious if marine biosecurity continues to be under-resourced and poorly monitored. Already we are seeing threats to the $150 million per year shellfish farming and export industry, as well as to traditional shellfish-gathering areas, affected by toxic algae. Although uncertain, it is highly possible that some of these types of algae have been carried here in ballast water, and to some extent may spread by the same means.

The Government has created an opportunity to address many of the issues associated with marine biosecurity and biodiversity through its funding package announced in June 2000 (see section 8). This includes $9.8 million over five years to develop information and management systems to enhance New Zealand's marine biosecurity, and $14.1 million over the same period on research programmes to increase our knowledge of our marine biodiversity.[18]

[18] *See http://www.biodiv.govt.nz.*

There is an opportunity for regional councils to be more involved in marine biosecurity through their coastal plans under the Resource Management Act, but the shortage of experience and expertise in this area in both central and local government needs to be addressed.

3.5.3 Import risk analysis

MAF Biosecurity Authority has prepared a draft policy statement on conducting import risk analyses and applying them to the development of import health standards (MAFBA, 2000e). The draft policy statement sets out the principles to which the Biosecurity Authority will adhere to manage risks associated with the importation of 'risk goods'. It principally covers the science-based assessment of risks and considers the potential effects on people, the economy or the environment of organisms that may be introduced as a consequence of importing risk goods. Biosecurity risk analysis under this draft policy does not consider the potential effects of importing the risk goods themselves (such as the economic effects on domestic producers or the benefits of the risk goods). MAF point out that the reason the draft policy does not consider this is that it is contrary to the Sanitary and Phytosanitary (SPS) Agreement. Also, section 22 of the Biosecurity Act, relating to the development of import health standards, focuses on reducing the impacts of risk goods and does not require the risks to be balanced against the benefits.

3.5.4 Appropriate level of protection against biosecurity risks

MAF Biosecurity Authority is leading an inter-departmental team to develop a statement on New Zealand's overall 'appropriate level of protection against biosecurity risks' (MAFBA, 2000b). This is a 'managed risk' approach, recognising that zero risk is unachievable. It is part of the Authority's biosecurity goal, which requires that by 2010 'MAF will have government-agreed risk management parameters that give an appropriate level of protection and that meet New Zealand's international obligations', and will include the consideration of risks to indigenous flora and fauna. 'Appropriate level of protection against risks' is a World Trade Organisation term under the SPS Agreement, which requires that measures applied to achieve a country's level of protection must be based on scientific principles.

MAF's proposal to develop an 'appropriate level of protection against biosecurity risks' is intended to contribute to two key government goals:

- to protect and enhance the environment
- to grow an inclusive, innovative economy for the benefit of all.

MAF needs to ensure that both goals are achieved and that an 'appropriate level of protection against biosecurity risk' includes risks to indigenous flora and fauna, biodiversity, ecosystem health and public health, and is incorporated into the Government's proposed Biosecurity Strategy.

3.5.5 The precautionary approach

The precautionary approach, in the context of environmental protection, is an approach to decision-making that adopts a conservative approach when the relevant information needed to make an informed decision is limited. A widely accepted definition is: 'where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation'.[19]

This approach is adopted in the Convention for Biological Diversity, but is not fully accepted as a basis for decision-making under the SPS Agreement[20] (see section 5). The precautionary approach is not, however, inconsistent with the use of risk analysis for decision-making. The SPS Agreement states (in Article 2) that 'in cases where relevant scientific information is insufficient' member countries of the WTO may provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information'. Any adoption of such measures is only provisional and member countries are required to endeavour to obtain any additional information necessary for a more objective assessment of risk.

[19] *United Nations Conference on Environment and Development, Rio De Janero, Brazil, June 1992 (Agenda 21).*

[20] *The relationship between the precautionary principle and the SPS Agreement was considered by the WTO Appellate Body in the EC hormone case. The Appellate Body found that the precautionary principle does find reflection in the SPS Agreement in Article 5.7 and other places, but that it does not override the obligations in Articles 5.1 and 5.2 of the SPS Agreement (to base biosecurity risk management measures on a scientific assessment of risk).*

MAF's risk analysis, based on internationally agreed methodologies and a scientific approach to justify its risk assessments, is suitable for assessing risks to primary production and export market access but is not adequate for assessing risks to ecosystems, including indigenous flora and fauna. This is particularly so where host testing has not been carried out on indigenous species and the impacts, including potentially irreversible ones, are uncertain (see appendix B). In such situations the precautionary approach (as defined in Agenda 21) is more appropriate, and involvement by DoC in the assessment and decision-making processes is essential.

3.6 Pest management strategies

The Biosecurity Act 1993 provides for the development and operation of two types of pest management strategies: national and regional (see Appendix A for further details).

The Biosecurity Council has produced a policy statement on the development of National Pest Management Strategies (NPMSs) by departments.[21] It provides guidance to central government biosecurity agencies when considering whether to initiate the development of an NPMS in addition to the prerequisites of section 57 of the Act. The policy statement recognises that, in some situations, responsibility for managing a particular risk may not be clear or that an organism clearly affects the responsibilities of more than one department. A Minister may then propose a NPMS to ensure that appropriate co-ordination takes place among the relevant departments. The policy statement outlines criteria for determining whether an NPMS should be developed, and by whom (ie if the beneficiaries can be identified), or whether it is more efficient and cost-effective to rely on other provisions of the Act.

The Biosecurity Council policy statement suggests that an NPMS should be developed for those exotic organisms or types of organisms (including endemic ones):

- for which it is more likely that an incursion will arise; and/or
- where their establishment will have serious impacts on natural resources; and
- where it is possible to identify the major beneficiaries and therefore those who should contribute to the costs of management or eradication of the particular organism or groups of organisms.

[21] *See the Biosecurity Council web site: http://www.maf.govt.nz/Biocouncil/policies/npms.htm.*

MAF point out that the Biosecurity Council's policy statement on the development of NPMSs by departments is being revised and is expected to be approved at the December 2000 meeting of the Council. The revision recognises recent experience with the development of pest management strategies, such as the situation with Varroa, where an exotic organism becomes established and continuous long-term management is necessary.

In addition to the two existing NPMSs (one for bovine Tb control and the other for American foulbrood in bees), two others have been proposed. The MoH released a discussion document on a proposal for an NPMS for exotic mosquitoes of public health significance (see section 10) but, with the approval of the Minister for Biosecurity, has subsequently decided not to proceed with it. MFish have developed a proposal for an NPMS for *Undaria* seaweed but, at the time of writing this report, its future is uncertain (see Appendix B.)

The benefits of an NPMS include its ability to specify:

- clear objectives
- responsibilities for implementation
- the period it will remain in force
- strategy rules
- compensation arrangements in respect of losses incurred as a direct result of the strategy
- sources of funding for its implementation.

The significance and effectiveness of an NPMS have to be weighed against other, less cumbersome (in terms of process) options for dealing with particular organisms under the Biosecurity Act, such as regional pest management strategies (RPMSs). RPMSs are more region-specific but could be an option, providing all regions agree on a co-ordinated effort to control a particular pest of national significance. This depends, of course, on all regional councils having an RPMS.

Pest management strategies focus on the control of particular organisms or types of organisms. Evidence from the case studies and background papers to this report suggests that biosecurity is more effective if the focus is on the control of pathways rather than pests. Nevertheless, pest management strategies are necessary for the continuous, long-term management of specific pest organisms.

3.7 Emergency management

Biosecurity incursions are unpredictable in terms of their timing, spread, effects and cost. The probability of an incursion may be relatively low but, as illustrated by the Varroa mite incident, the consequences and costs can be large. Timeliness is a key factor in whether or not a response to an incursion will be successful and cost-effective. In most cases this means having the capacity, authority and resources to take the right action at the right time to avoid or minimise harm.

Preparation for emergencies, including clear funding arrangements, accountability and co-ordination of resources and skills, is the key to effective responses. The skills required not only include expertise in the organism in question, but also in the logistics of organising and running an effective emergency response operation. In some cases, the skills required may lie outside the relevant biosecurity agencies. It is important that, in such circumstances, agencies are adequately resourced to call in the necessary expertise to enable them to undertake an effective response.

Through its allocation of biosecurity funding, the Government has given MAF Biosecurity Authority the responsibility for carrying out the initial inquiries and assessment of an exotic organism, not already declared unwanted, where the responsibility for responding may not be immediately apparent. But responsibilities for any subsequent response, such as eradication or longer-term control of exotic pests or diseases, are not so clear and are currently the subject of negotiations between MAF and the other biosecurity agencies with a view to developing memoranda of understanding. In general terms, the type of pest or disease and what it affects largely determines who should deal with it. For example, the MoH has taken responsibility for eradication of the southern saltmarsh mosquito discovered in Hawke's Bay and elsewhere, and has been funded to do this as a 'specific pest and disease response' output.

Another issue is that of hand-over arrangements after MAF Biosecurity Authority has undertaken an initial investigation and found that the ongoing responsibility for eradication or control lies with another agency (see Appendix B – banjo frog case study). It is important that work underway to develop memoranda of understanding or agreement between MAF Biosecurity Authority and the other biosecurity agencies proceeds without delay and that firm agreements are reached on responsibilities for any subsequent actions to deal with exotic pests and diseases. In cases where an incursion and its effects involve more than one agency, it is important to clarify each agency's responsibilities and how decisions are to be made. If the responsibilities of agencies are not clear, there is the potential for matters to be overlooked or for confusion to arise over accountability for decisions. The white spotted tussock moth eradication programme in Auckland in 1997 is an example of agencies working together, under the leadership of one agency (Ministry of Forestry) towards a common goal. The programme not only considered the most effective options for eradicating the moth, but also the potential impacts on the environment and public health of the method used. Local communities were kept well informed about the aerial spraying schedule, and residents had access to those who managed the programme to enable their concerns to be dealt with.

3.7.1 Funding for emergencies

At present there is no fund established for the sole purpose of covering the costs of an incursion response. Biosecurity agencies either have to draw from their own resources by reprioritising or suspending some programmes, or seek Cabinet approval for additional funding on a case-by-case basis. This process can be time-consuming and deflect resources away from the response itself.

MAF Biosecurity Authority is funded, among other things, for:

- the delivery of services for the surveillance of domestic animal and plant populations and forests, the purpose of which is to maintain an accurate knowledge of New Zealand's animal, forest and plant health status
- the delivery of services to maintain a capability to diagnose and respond to unrecorded, unwanted organisms that are detected
- initial investigations into suspected unwanted organisms.

DoC is funded to respond to exotic disease or pest incursions in indigenous forests and other natural ecosystems, including a specific programme to eradicate and control *Undaria* seaweed in southern New Zealand. DoC funding includes the examination of indigenous tree species within five kilometres of specified ports for new introduced insects and diseases, and the provision of indigenous forest health diagnostic and advisory services and field evaluations.

The MoH (through public health services) undertakes all the surveillance and responses to interceptions and incursions of exotic mosquitoes of public health significance.

MAF receives funding for 'Disease and Pest Surveillance Response Capability' (Output Class D4). In the 2000/01 Estimates of Appropriations this amounts to $17.601 million, or about 18% of MAF's allocation from Votes: Biosecurity. DoC receives $648,000 under Vote: Biosecurity – Conservation for the delivery of services associated with responses to exotic disease or pest incursions, including the costs of the *Undaria* seaweed eradication and control programme. Other ongoing animal pest and weed control programmes are funded through Vote: Conservation. The MoH's work on eradication of the southern saltmarsh mosquito is funded through Vote: Health.

Incursion response involving the mobilising of resources to eradicate an exotic pest or disease varies depending on the circumstances, but generally the response carries a high cost. For example, the programme to eradicate white spotted tussock moth in Auckland in 1997 cost about $12 million. In April 1999 the previous government committed up to $6.4 million to eradicate the southern saltmarsh mosquito in Hawke's Bay. MAF's painted apple moth response has so far cost $790,000, which was met from within MAF's existing Vote: Biosecurity baselines, but involved reprioritisation of outputs. The Government has agreed to a programme over the next two years to eradicate the painted apple moth. This will cost $1.473 million in the first year, followed by a monitoring programme to confirm eradication at a cost of $281,000 in the second year (see Appendix B).

Such costs need to be compared with the cost of doing nothing. A conservative estimate based on the impact of painted apple moth on private and public amenity and plantation forestry was $47.6 million over 20 years (see Appendix B). The cost of the Varroa mite to the entire agricultural industry and the economy has been estimated at between $400 million and $900 million over the next 30 to 40 years.

Budgetary constraints on biosecurity agencies potentially hinder their ability to respond rapidly to emergency situations. Such constraints place unnecessary pressure on emergency management decision-makers, and on longer-term programmes (eg risk analysis work and systems development), which departments may have to place on hold while resources are diverted to emergency management.

But the option of providing a contingency fund for emergency response is not without its problems. A dedicated fund for biosecurity emergencies has a price, as the amount set aside cannot be spent. Such a contingency fund may appear to be 'unproductive' when not actually called upon, and its benefits – which consist of the cover it provides, rather than payouts made – may be harder to justify against continuously needed services such as border control.

Another option would be for the government to take out insurance offshore to spread the risk over an even larger and more diversified pool of contributors (NZIER, 2000).

Funding of biosecurity emergency responses is an issue that needs to be looked into as a matter of urgency. Current *ad hoc* funding arrangements have the potential to delay, and therefore lead to increased costs of responses. Sources of public and private contributions need to be identified, and criteria for contributing to and accessing emergency response funds need to be established. A successful example is the fund set up to manage marine oil spills.

4.1 Consultation

The Biosecurity Act contains a number of provisions regarding consultation. These include:

- a requirement that CTOs consult with interested parties on proposed import health standards or on related documents that analyse or assess the risks (s 22)
- the procedures for notifying and receiving submissions on a proposed NPMS (s 62)
- a requirement that regional councils consult with relevant Ministers, local authorities and tangata whenua during the preparation of proposed RPMSs (regional councils *may* consult with any other parties) (s 73)
- consultation with parties likely to be affected by a proposed levy[22] (s 92)
- a requirement that the Minister consult with such persons as are considered to be representative of interests involved in an emergency, before the Minister recommends that the Governor-General declare a biosecurity emergency or introduce biosecurity emergency regulations (ss 144 and 150).

MAF Biosecurity Authority has produced a consultation policy (MAFBA, 2000f), which sets out the Authority's approach to consultation and the requirements it has of its staff. The policy aims to provide consistency and transparency in the consultation process and practice across the Authority.
The reasons for consulting, outlined in the policy, are to:

- make practical decisions
- improve public understanding of MAF Biosecurity Authority decisions
- improve compliance with regulatory decisions
- maintain and build relationships and credibility
- learn others' views and extend MAF Biosecurity Authority's knowledge base
- consider the expectations of interested parties (including the Government)
- fulfil statutory obligations
- fulfil international treaty obligations
- comply with administrative law provisions
- fulfil Treaty of Waitangi obligations.

[22] *Under s 90 of the Biosecurity Act, a levy may be imposed through an Order in Council to wholly or partly fund the implementation of a pest management strategy.*

Implementation of MAF Biosecurity Authority's consultation policy needs to be monitored and reviewed on a regular basis to ensure that it is achieving its purpose, described by MAF as 'to enhance the quality of MAF's decisions, improve relationships and fulfil obligations' (MAFBA, 2000f).

Maori have expressed concerns about the lack of consultation with tangata whenua on biosecurity matters at a national level (further details are included in section 9). The lack of processes for consulting with Maori on biosecurity issues is inconsistent with other institutional and legislative frameworks dealing with concerns about organisms being introduced into New Zealand (eg the HSNO Act). There is a requirement for regional councils to consult with specified parties, including tangata whenua (s 73 of the Biosecurity Act), but there is no equivalent provision in the Act for the Minister to consult on matters of national significance. It is important to encourage input from tangata whenua, acknowledging not only the Crown's obligations under the Treaty of Waitangi but also the contribution that traditional knowledge can make to biosecurity monitoring, surveillance, decision-making and priority-setting.

In general, the system and processes for managing biosecurity risks to New Zealand need to ensure that, as far as possible, all interests, values and expectations are taken into account. Poor consultation can lead to poor decision-making, inadequate or inappropriate action, and (eventually) undesirable outcomes such as irreversible damage or changes to vulnerable ecosystems in New Zealand.

As discussed in section 3, minor changes to the representation on the Biosecurity Council, and its consultative forums and their terms of reference, could improve the participation by stakeholders in biosecurity policy development and enhance the quality of advice given to the Minister for Biosecurity. The collective knowledge of interested parties such as industry, science and research organisations, non-governmental organisations and others could be used to develop and provide support for biosecurity initiatives.

4.2 Public awareness

4.2.1 At the border

As a key element of the overall biosecurity system, MAF Quarantine Service border control inspection at international airports has a significant role to perform in increasing public awareness about biosecurity risks. The presence of uniformed staff, detector dogs, x-ray equipment, amnesty bins and posters in a variety of languages all contribute to a strong message for visitors and returning residents that New Zealand has more stringent biosecurity requirements than many other countries. This is also reinforced by a requirement that all in-coming passengers fill in declaration forms before arrival in New Zealand.

In addition to its passenger-screening process, MAF Quarantine Service has produced in-flight videos explaining the biosecurity requirements of New Zealand. It is not helpful when, in some cases, airlines have either refused or omitted to run the in-flight video prior to landing.

Information obtained during the course of this investigation has revealed that the MAF Quarantine Service budget for public information and awareness has been significantly reduced in recent years – from around $500,000 in 1996/97 to $86,000 in 2000/01. There is a risk that budget constraints leading to failure to maintain a high level of public awareness about biosecurity risks to New Zealand, particularly among importers and arriving passengers, will result in far higher economic, environmental and social impact costs associated with exotic pests and diseases and their eradication or long-term management.

A survey undertaken for MAF by Massey University and MAF Quarantine Service (Rauniyar *et al*. 1999) highlighted a number of issues associated with the travelling public's awareness of New Zealand's biosecurity requirements. The findings of the survey included the following points:

- understanding of and compliance with New Zealand's quarantine regulations by arriving passengers is a crucial factor in protecting New Zealand's environment and primary industry
- there are substantial knowledge gaps in passengers' awareness of New Zealand's quarantine declaration requirements, and there is apprehension and confusion about the declaration of quarantine items

- the requirement that every passenger arriving in New Zealand goes through the biosecurity area causes no major discomfort for passengers
- the most effective strategies influencing passenger behaviour, other than a bench search, have been the x-ray machines, quarantine detection dogs and the quarantine/ customs declaration forms
- airlines do not have a coherent policy towards the screening of videotapes and providing New Zealand quarantine information in the aircraft
- there is a perception by many in the travel industry that disseminating quarantine information is solely the responsibility of MAF Quarantine Service and the New Zealand Government, and is not an obligation for travel agents, tour operators or airlines
- there was less awareness of New Zealand's quarantine requirements among the youngest (under 20 years) and oldest (65 years and older) groups
- increasing passenger awareness would require continued effort in various forms and at various levels, including the co-operation of all stakeholders.

While MAF's rate of detection of biosecurity breaches has increased substantially in recent years, the issue of poor or no understanding among some incoming passengers needs to be analysed to determine what additional measures may be necessary to increase the level of awareness of and compliance with biosecurity requirements.

During the preparation of this report, the Government was considering an amendment to the Biosecurity Act that would enable border inspection staff to impose a $200 instant fine on arriving passengers found in possession of undeclared banned products. MAF announced that a new public awareness programme would accompany this.

There is clearly a need for stringent measures such as heavy fines, particularly against those who deliberately or carelessly attempt to bring in risk goods. Heavy fines, supported by public information, give a strong signal to passengers and importers that New Zealand is not prepared to tolerate deliberate or careless flouting of biosecurity requirements.

4.2.2 Post-border

Members of the public have detected a number of biosecurity incursions. Examples include the painted apple moth, the southern saltmarsh mosquito, the Australian banjo frog, subterranean termites, and snakes (see case studies in Appendix B). Experience suggests that unwelcome visitors such as insects and reptiles are more likely to be noticed and reported by members of the public than are unusual plants or pathogens. Not surprisingly, marine invasives are far less likely to be spotted quickly (Green, 2000).

Auckland Regional Council has published a number of well-illustrated booklets and other material on plant pests, to encourage residents in the region to report new and potential pests. The Council has also published a booklet giving guidance to gardeners on plants to use in place of common plant pests (ARC, no date).

During 2000 several biosecurity breaches involving dead and live snakes, scorpions and exotic spiders found in containers or packing material of goods shipped to New Zealand have been highlighted by the media. Such incidents may be regarded as a failure of the border inspection system, but it must be acknowledged that incursions are inevitable. Border control systems can never provide 100% protection against biosecurity incursions, so post-border monitoring and surveillance is essential.

Members of the public are a largely untapped biosecurity monitoring resource, particularly in communities near major entry points, such as international airports and ports. There is a need for central and local government agencies to work together on strategies to increase public awareness about biosecurity risks.

4.3 Communication

Communication among agencies and the public will largely determine the success or otherwise of biosecurity risk management. Risk communication is a two-way process between decision-makers and affected parties that enables information to be exchanged for the purpose of better decision-making, and all parties to work towards an agreed outcome (eg an acceptable level of risk).

MAF Biosecurity Authority uses its publication *Biosecurity* to announce new import health standards, and provide updates on current biosecurity issues such as progress on managing pest incursions and new policies.

The Biosecurity Authority has, however, gained a poor reputation for responding to inquiries or advice sought from individuals, groups or other government departments. Consultation with stakeholders during the course of this investigation revealed communication problems between MAF Biosecurity Authority and some individuals and groups interested in, or affected by, biosecurity risk management. There was also evidence of what appeared to be poor consultation between MAF Biosecurity Authority and the Department of Conservation (on the painted apple moth response), and between MAF Biosecurity Authority and Forest Research, one of the Crown research institutes that provide the Authority with scientific support (on the issue of a new contract clause).

In addition to its policy on consultation, MAF Biosecurity Authority needs to consider developing a policy on responding to public and inter-agency inquiries. This needs to encourage a more 'open' approach to information sharing and the provision of advice. There is also a need to improve working relationships, through improved consultation with the aim of achieving biosecurity outcomes.

5.1 Pre-border

New Zealand cannot rely only on border inspection of goods and passengers entering New Zealand as our 'first (and only) line of defence' against unwanted organisms, pests and diseases. In fact the actual first lines of defence are preventive measures such as:

- international agreements
- import health standards for risk goods
- pre-border checks and certification of risk goods prior to their export to New Zealand
- 'early warning' systems, intelligence-gathering and information-sharing involving international co-operation.

International agreements relevant to biosecurity are divided roughly into two groups that cover:

a) measures to prevent the opportunity for invasive species to enter new ranges (ie quarantine)

b) efforts to limit the spread and impact of invasives once they are established in a new range (see Green, 2000).

Current international scientific thinking indicates that effective quarantine is practical only in an island nation such as New Zealand. Generally, nations with land borders find effective quarantine difficult and costly. As this point suggests, New Zealand's isolation from the rest of the world has significant implications that require us to seriously consider the responsibility we have to protect our unique flora and fauna, but also capitalise on the natural advantage we have in our ability to exclude unwanted organisms.

The general rule regarding the importation into New Zealand of things likely to pose a biosecurity risk is to prohibit entry unless an import health standard has been issued in accordance with the Biosecurity Act (s 22) (see Appendix A.1.1). An import health standard specifies the requirements for the effective management of the risk associated with the import. Such requirements must be met before biosecurity clearance can be given and the product permitted entry into New Zealand.

An example of pre-border checks and treatment of goods destined for New Zealand is the 'off-shore' inspection and cleaning of Japanese used vehicles destined for New Zealand. Under this arrangement, set up by a company involved in the transport of the vehicles and other machinery, MAF carries out the inspections of the used vehicles in Japan, and if the vehicles do not meet the required standard of cleanliness, the company cleans them before export. This arrangement has the advantage of clean cars arriving at New Zealand ports, and only a small risk of re-infestation after cars are cleaned and awaiting shipment. MAF advise that there has been no significant difference in the level of infestation (eg by gypsy moth) by inspecting offshore or in New Zealand. Among the findings of a report examining the biosecurity risks from used cars imported from Japan, with particular reference to risks to New Zealand's forests and trees, were the following (Hosking, 2000):

- Biosecurity risk mitigation should focus on pathways, not individual organisms, thereby accommodating both the known and unknown risks.
- The important biosecurity principle of risk separation between the risk organism and potential establishment sites must be applied.
- There is strong precedent both in New Zealand and overseas for biosecurity strategies that apply risk separation by confining the risks offshore.

'Early warning' systems include those that foster exchanges of information on potential pest and disease movements between countries. The IUCN guidelines on invasive species are an example of such a system.

5.1.1 IUCN guidelines

The IUCN (World Conservation Union) Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species (IUCN, 2000) contain guiding principles on the prevention and introductions of alien invasive species. The goal of the guidelines is to prevent further losses of biological diversity due to the deleterious effects of such species. The intention is to assist governments and management agencies to give effect to Article 8(h) of the Convention on Biological Diversity (see section 7).

Among the IUCN's recommended actions to reduce the likelihood of unintentional introductions is the need to identify and manage pathways such as national and international trade, tourism, shipping, ballast water, fisheries, agriculture, construction projects, ground and air transport, forestry, horticulture, landscaping, pet trade and aquaculture. The guidelines also recommend collaboration between international trade authorities and industry associations to encourage industry codes of conduct and other measures. Among the benefits of such links would be access to and sharing of information or 'intelligence' about emerging risks and pathways, although, as pointed out in another paper (Mack *et al*., 2000), identifying future invaders and taking effectives steps to prevent their dispersal and establishment constitutes an enormous challenge to both conservation and international commerce. The paper by Mack *et al*. goes on to suggest that control of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders.

5.2 Border

New Zealand has a single border control service for managing biosecurity threats posed by incoming passengers and goods. MAF Quarantine Service regularly seizes high-risk material, such as fruit containing fruit fly larvae, which is not declared by passengers and goods. MAF Quarantine Service officers successfully use passenger risk profiles to help them determine which passengers to select for more detailed screening. Several successful prosecutions of passengers carrying prohibited goods have been taken, and court fines have, in some cases, exceeded $10,000 (Budd, 2000).

By 1996, when the Mediterranean fruit fly outbreak was discovered, the detector dog programme was already in place at international airports. X-ray scanners were installed in early 1997 to screen incoming passengers' luggage. The overall risk detection rate at international airports is about 90%.

At the international mail centre in Auckland, x-ray machine and detector dog screening and inspection have been used since 1999 to inspect all incoming international parcels and letters for organic material likely to be a biosecurity threat. These measures have resulted in the rate of detection of seizures increasing significantly, from 55% to between 85 - 95%.

It is through the development of passenger border control services at Auckland, Wellington and Christchurch international airports that some sophisticated biosecurity initiatives have been developed such as:

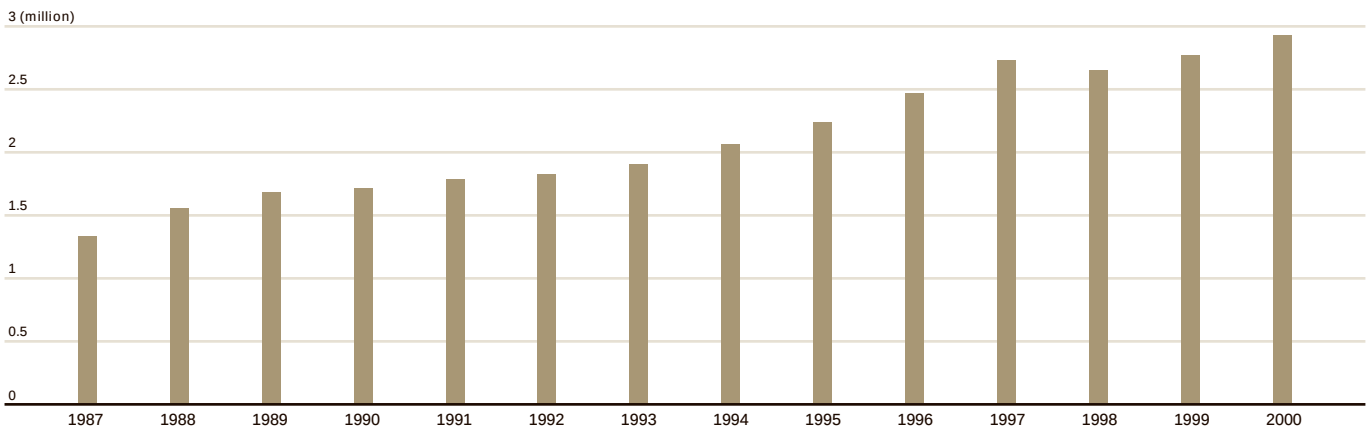
- border data collection and information dissemination to interested parties
- a comprehensive methodology for assessing the success rate for border control
- an internationally recognised dog-training programme
- a multi-pronged approach to detect and eliminate risk goods.

Despite these measures, growth in the numbers of passengers and goods arriving in New Zealand is continuing to put pressure on the biosecurity system:

- the number of overseas aircraft arriving in 1999/2000 increased by 10% over the previous year, and passenger numbers increased by 4%
- aircraft arrivals have nearly doubled in the last seven years
- the number of containers inspected in 1999/2000 has jumped by 37% compared with the previous year, and the number of contaminated containers found was double the 1998/99 number
- the volume of mail screened has increased more than tenfold since the use of x-ray scanners and detector dogs on all arriving letters and packages; and the number of mail seizures has more than doubled between 1998/99 and 1999/2000 (Whyte, 2000).

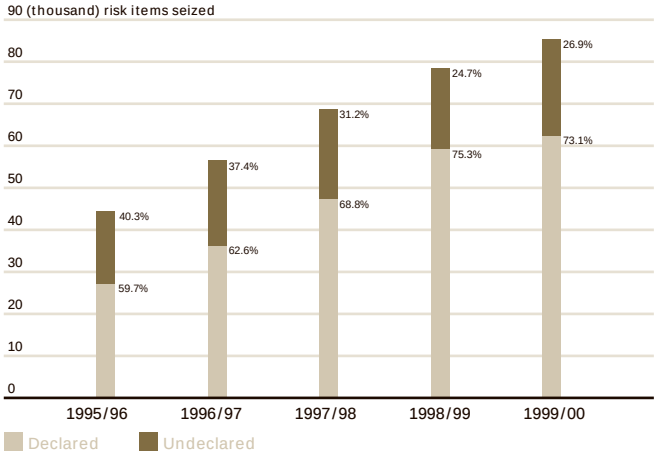
Total passenger arrivals in New Zealand have more than doubled in the last 13 years (Figure 5). Along with an increase in passenger arrivals comes an increase in biosecurity risk – aircraft and passenger seizures of risk items have almost doubled over the last five years (Figure 6). It is encouraging to note the increasing trend in the percentage of risk items that are declared. Seizures of risk items by MAF Quarantine Service at Auckland, Wellington and Christchurch international airports are typically food items such as fruit fly host material, meat and poultry products.

Figure 5. Total passenger arrivals in New Zealand, 1987-2000 (year ended 31 March)



Source: Statistics New Zealand, 2000

Figure 6. Aircraft and passenger seizures of risk items in New Zealand, 1995/96 - 1999/00



Source: Whyte, 2000

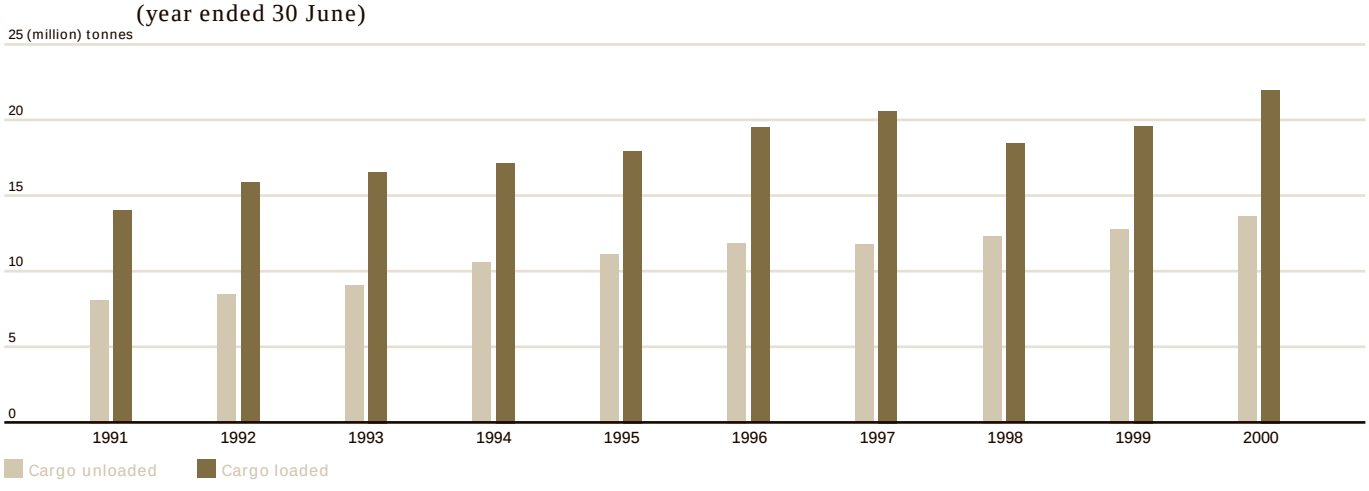
There has been an increase in the weight of overseas cargo loaded and unloaded at New Zealand air and sea ports over the last 10 years, a reflection of global trade liberalisation (Figure 7). While the weight of overseas cargo unloaded does not indicate the actual biosecurity risk of goods, the increase in weight does imply that risk pathways are getting larger. Note that the weight of cargo unloaded has nearly doubled in a 10-year period.

Ports with the highest weight of overseas sea and air cargo unloaded in the June 2000 year are Whangarei (4.6 million tonnes), Auckland (3.5 million tonnes), Tauranga (1.2 million tonnes), Lyttelton/Christchurch (0.97 million tonnes), Invercargill (0.97 million tonnes) and Wellington (0.84 million tonnes).[23] In the June 2000 year, Auckland unloaded 86.8%, by weight, of all overseas cargo unloaded at airports in New Zealand.

The number of sea containers arriving at two major New Zealand ports (Tauranga and Lyttelton) has more than doubled in the last 10 years (Figure 8). As more and more cargo tends to be carried by sea container, greater attention needs to be paid to this risk pathway to ensure that the risk is being identified, assessed and managed.

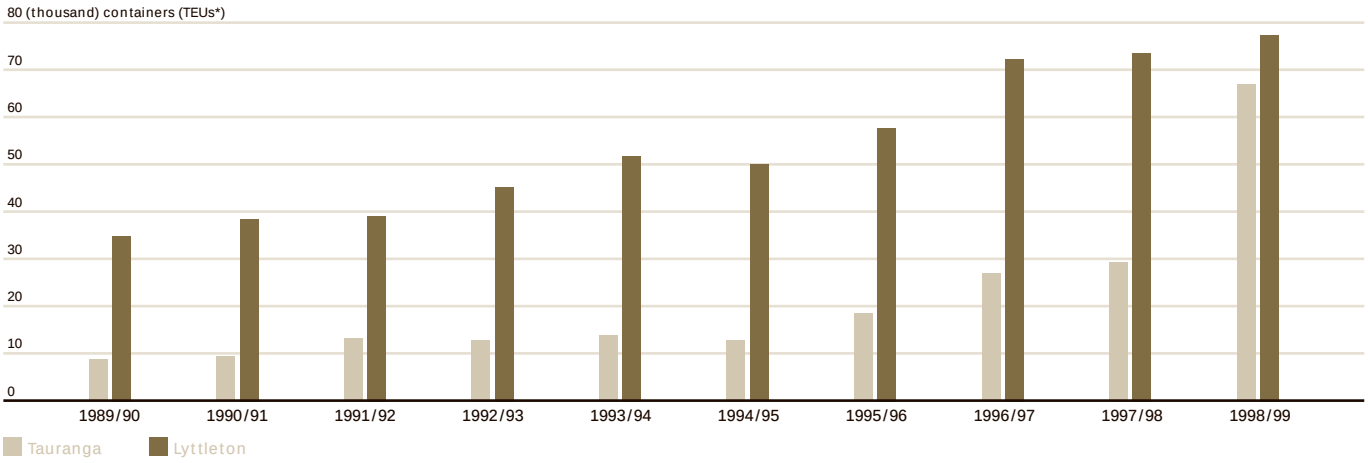
[23] *http://www.stats.govt.nz/.*

Figure 7. Gross weight of overseas cargo loaded and unloaded at New Zealand air and sea ports, 1991-2000 (year ended 30 June)



Source: Statistics New Zealand web site (http://www.stats.govt.nz)

Figure 8. Container arrivals at Tauranga and Lyttelton ports, 1989/90-1998/99

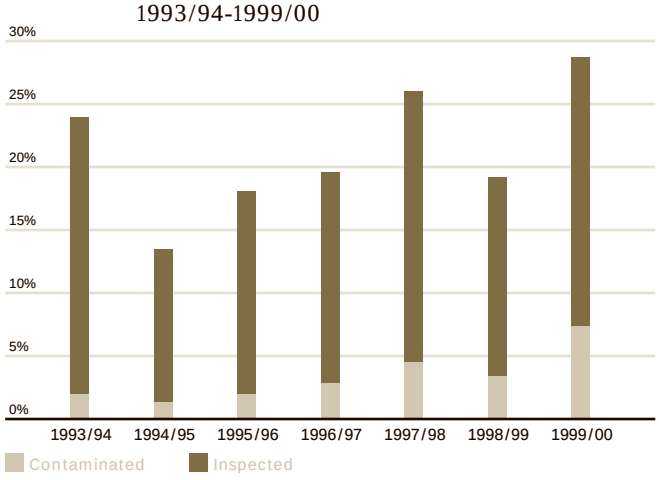


**TEU = Twenty-foot equivalent units*

Source: Port companies' data, 2000

While the percentage of overseas sea container inspections has fluctuated from year to year, the percentage of inspected containers that are contaminated has increased by 18% over the last seven years (Figure 9).

Figure 9. Percentage of overseas sea containers inspected and contaminated in New Zealand, 1993/94-1999/00

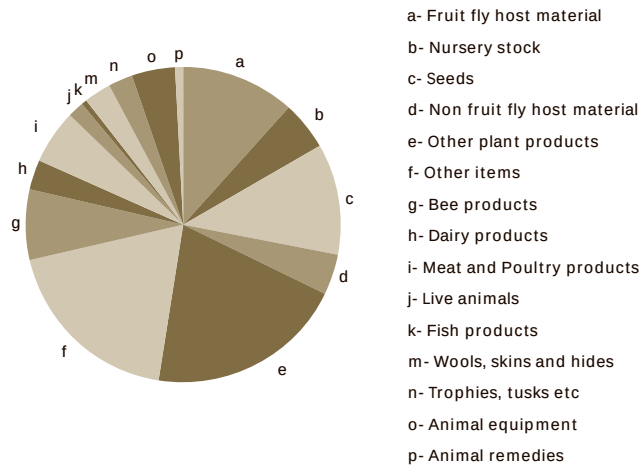


Source: Whyte, 2000

The trends illustrated in the last three graphs are of concern as they all indicate that the possible biosecurity risk to New Zealand is increasing.

Fruit fly host material accounted for 11% of all air cargo seizures of risk items in New Zealand in 1999/00 (Figure 10), but for less than 1% of both sea cargo and mail seizures. Seeds accounted for 23% of mail seizures of risk items in New Zealand in 1999/00 (Figure 11), while accounting for 4% and 12% of sea and air cargo seizures respectively. This volume of seeds seized in the mail is of particular concern, and could be related to the high compliance cost imposed by the new HSNO Act process (see 3.5.1) or simply the lack of awareness of New Zealand's biosecurity requirements.

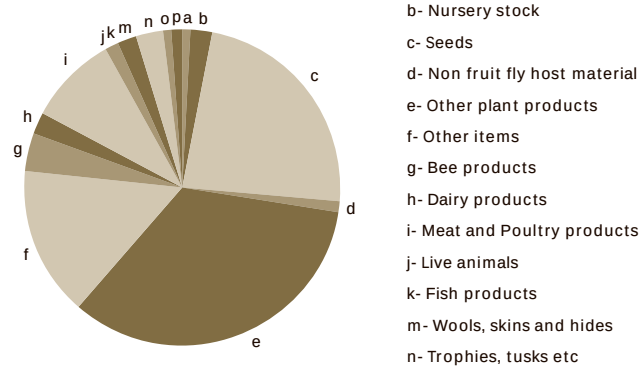
Figure 10. Classes of air cargo seizures of risk items in New Zealand, 1999/00



a- Fruit fly host material
b- Nursery stock
c- Seeds
d- Non fruit fly host material
e- Other plant products
f- Other items
g- Bee products
h- Dairy products
i- Meat and Poultry products
j- Live animals
k- Fish products
m- Wools, skins and hides
n- Trophies, tusks etc
o- Animal equipment
p- Animal remedies

Source: Whyte, 2000

Figure 11. Classes of mail seizures of risk items in New Zealand, 1999/00



a- Fruit fly host material
b- Nursery stock
c- Seeds
d- Non fruit fly host material
e- Other plant products
f- Other items
g- Bee products
h- Dairy products
i- Meat and Poultry products
j- Live animals
k- Fish products
m- Wools, skins and hides
n- Trophies, tusks etc
o- Animal equipment
p- Animal remedies

Source: Whyte, 2000

5.2.1 Shipping containers

A growing concern is the biosecurity risk posed by shipping containers, given the ideal conditions they offer for a wide range of invasive hitchhikers, from slugs to insects to snakes. The increasing numbers of containers being processed through New Zealand ports (approximately 360,000 per year) means that current resources and inspection techniques only allow for the inspection of a small percentage of the total number arriving here, even though the total number inspected is impressive (Green, 2000).

Green also refers (p 16) to a study by Forest Research of risks to New Zealand forestry from contaminants on the external surfaces of containers, which concluded that the nature and frequency of occurrence of contaminants on the external surfaces of shipping containers represents a risk to forestry in New Zealand.

5.2.2 Training and performance standards

MAF Quarantine Service provides border control services not only for MAF, but also MFish, DoC and MoH. Such a wide range of interests to cover means that border inspection staff need the appropriate training and guidance necessary for the delivery of an effective service. It is important, therefore, for each department to ensure that MAF Quarantine Service has appropriately trained staff and that the Service achieves performance requirements set by each contracting department.

5.3 Post-border

Post-border biosecurity refers to activities designed to detect, investigate, eradicate or manage pests and diseases present in New Zealand.

In some cases an incursion can be detected early and successfully eradicated (eg white spotted tussock moth in Auckland). In others, the incursion may not be discovered until some time after it has entered New Zealand, by which time it may have become established and spread (eg the Varroa mite infestation). Appendix B has further details of particular case studies.

Generally, first attempts at eradication of newly discovered incursions are dealt with by central government (eg mosquitoes, painted apple moth, banjo frog, snakes). Regional councils tend to deal with animal and plant pests that have become established but need to be controlled because of their economic or environmental impacts (eg possums, weeds). The Pest Management Strategy Advisory Committee is a forum providing regional councils and MAF Biosecurity Authority the opportunity to regularly discuss biosecurity issues affecting central and local government.

The private sector has demonstrated, in the case of the Varroa mite, that it can provide a significant contribution towards investigating the extent to which an incursion has spread. The Biosecurity Consultative Forum enables a range of stakeholders in the public and private sectors to co-operate, communicate their interests, and generally contribute to New Zealand's biosecurity.

There are clearly efficiencies to be gained from central and local government agencies working together, and from the combined efforts of the public and private sectors and research organisations, to respond effectively to post-border impacts of pests and diseases. The Biosecurity Council is at the hub of the biosecurity consultation network and, as such, should encourage the participation of stakeholders who need to be, but are not currently, involved.

5.4 Monitoring and surveillance

The case studies in Appendix B and the background paper by Green (2000) highlight the importance of having effective monitoring and surveillance systems to track existing and emerging biosecurity risks and pathways.

Monitoring involves the passive collection and collation of data on current human, animal, plant and ecosystem health status, and biodiversity. Surveillance refers to active measures to detect new pest and disease incursions and changes in the distribution and prevalence of endemic pests and diseases (Nairn *et al.*, 1996).

Monitoring and surveillance are important in fulfilling international obligations (eg the International Plant Protection Convention). They also assist in the management of biosecurity by identifying the risks, costs, resource allocation, and measurement and assessment of performance of the biosecurity system with respect to the outcomes being sought.

During the course of this investigation, stakeholders identified biosecurity monitoring and surveillance as areas that needed more attention. Interestingly, in the Estimates of Appropriations for the year ending June 2001, 25% of Votes: Biosecurity goes to surveillance and control programmes – the second highest departmental output area in percentage terms after border control (49%). Additional funding for surveillance is provided for DoC and MoH under Vote: Conservation and Vote: Health, and regional councils undertake their own monitoring and surveillance associated with their responsibilities. So it would appear that a wide range of monitoring and surveillance is taking place.

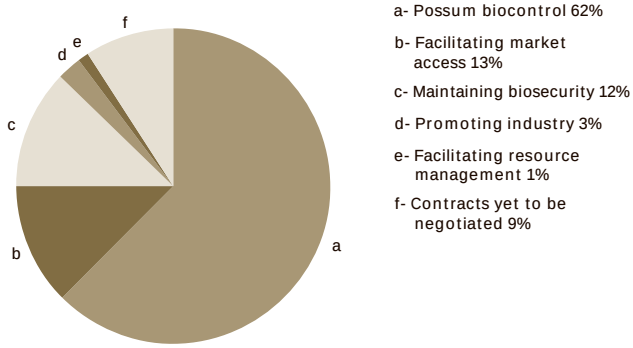
However, there may be scope for monitoring and surveillance to be better targeted and co-ordinated. There is a need to explore opportunities that would encourage and improve monitoring, surveillance and information-sharing between central and local government biosecurity agencies, as well as between the public and private sectors. These issues need to be further developed as part of the Government's proposed Biosecurity Strategy.

5.5 Operational research funded by biosecurity agencies

5.5.1 Ministry of Agriculture and Forestry (MAF)

MAF Policy funds operational research, a part of which relates to biosecurity. Operational research in progress purchased by MAF Policy is outlined in their *Research in Progress* document (MAF, 1999b). Figure 12 shows that of MAF's $4.7 million operational research budget for 1999/00, $582,712 (or 12%) is allocated to the category 'maintaining biosecurity'.

Figure 12. Allocation of MAF operational research funding 1999/00



Source: MAF, 1999b

The purpose of MAF's operational research is to:

- support policy advice to Ministers
- assist with the execution of statutory duties
- support purchasing decisions
- evaluate practice, programmes or policies funded by other organisations or departments
- support departmental advisory services to industry or the community
- support the production of specific outputs.

Specific research being undertaken in the 'maintaining biosecurity' outcome-driven category is intended to provide 'information which will assist in developing and implementing policies which help to protect New Zealand's agricultural, horticultural and forestry industries from the adverse effects of introduced pests and diseases' (MAF, 1999b).

Biosecurity research programmes in 1999/2000 include:

- DNA diagnostic procedures for the identification of selected species and populations of *Lymantria* and *Orgyia* (invasive moths) from intercepted egg masses
- assessment of contamination soil as a risk pathway
- identification of fungal infections in imported timber
- validation of pest-host associations.

Some research is also carried out within MAF's existing baselines, particularly relating to newly discovered organisms.[24]

5.5.2 Department of Conservation (DoC)

DoC has a total research budget of almost $9.5 million.[25] The amount to be spent on biosecurity risk management in 2000/01 ($121,000) represents approximately 1.3% of DoC's total research budget. In 1999/2000 approximately $1.75 million was spent on research into animal pests and almost $550,000 was spent on research into plant pests.

Since 1997 DoC has funded research on assessing biosecurity risks to the natural environment. Specific research carried out includes that on:

- terrestrial ecological weeds
- aquatic freshwater weeds
- invertebrate pests and plant diseases of indigenous forests
- exotic diseases of indigenous wildlife populations
- translocation pathways of marine pests to highly valued areas.

DoC has also published a number of biosecurity risk assessment reports[26] on indigenous flora and fauna.

[24] *Recent examples include investigations into the distribution of chytrid fungi among amphibians, the distribution of* Perkinsis olseni *in bivalve molluscs, the technical feasibility of a response to the* Varroa *mite, a delimiting survey of the Argentine ant, a delimiting survey of scoliid wasps, and the development of laboratory capability for exotic and endemic diseases (MAF comments to PCE, 13/11/00).*

[25] *Dr Geoff Hicks, Department of Conservation, pers. comm., 1/8/00.*

[26] *Development of a method for evaluating the risk to New Zealand's indigenous fauna from the introduction of exotic diseases and pests – including a case study on native parrots,* Science for Conservation *138; Border control for potential aquatic weeds – Stage 1, weed risk model,* Science for Conservation *141; Threats to New Zealand's indigenous forests from exotic pathogens and pests,* Science for Conservation *142; Assessing the risk to indigenous New Zealand biota from new exotic plant taxa and genetic material,* Science for Conservation *143.*

5.5.3 Ministry of Fisheries (MFish)

Most of the research commissioned to date by MFish has been analysis of the ships' ballast water risk pathway. MFish has partly funded research carried out by the National Institute of Water and Atmospheric Research (NIWA) on fouling on hulls of vessels arriving from overseas. The Cawthron Institute and NIWA have been funded to classify organisms found as part of a public awareness surveillance programme. The Cawthron Institute was also funded to develop options for managing Undaria. In collaboration with Battelle (US), the Institute has carried out research for MFish on ballast water exchange verification methods at a cost of $330,000 spread over 2 years.

The Ministry's expenditure on operational research since it took responsibility for ballast water issues in 1997 has been, on average, about $170,000 per annum.

5.5.4 Ministry of Health (MoH)

MoH funding of biosecurity research in recent years has mainly focused on exotic mosquitoes. The Ministry's expenditure on this over the last three years and in this current year ranges from $40,000 (2000/01) to almost $223,000 (1999/2000).

Examples of MoH-funded research can be found in section 10.

5.5.5 Ministry of Research Science and Technology (MoRST)

MoRST's role is to actively promote the use of rigorous scientific and analytical techniques for the management of biosecurity risks (Sinner and Gibbs, 1998b, p110). MoRST, through the Foundation for Research, Science and Technology (FRST), has a role in administering the Public Good Science Fund.

5.6 Other research

5.6.1 The Public Good Science Fund (PGSF)

From 1996-98, the PGSF has funded research on specific biosecurity-related topics (MoRST, 1998), such as:

- bio-control of the Asian gypsy moth
- invasive weeds and natural ecosystems
- management strategies for invasive aquatic weeds
- the health of New Zealand's forests.

Biosecurity-related research funded by the PGSF in 1998/99 (some of which continues into 1999/2000) includes:[27]

- nationally significant biological collections (Landcare Research)
- biosystematics of New Zealand fungi and bacteria (Landcare Research)
- biosystematics of New Zealand land invertebrates (Landcare Research)
- invasive invertebrates in natural ecosystems (Landcare Research)
- improving the environmental safety of biocontrol (AgResearch)
- systematics of New Zealand *Mirinae* (Hemiptera) (Dr A C Eyles)
- developing international forest pest research capability (HortResearch).

The total allocation for the above research is almost $3 million.

Within the 2000 framework, $500,000 is specifically allocated to biosecurity, involving risk assessment and detection systems for insects and plant pathogens.

5.6.2 Crown Research Institutes

HortResearch currently has a contract to MAF to identify pheromones to attract painted apple moth. HortResearch also has some FRST work developing cures for the recent incursion of clover root weevil *(Sitona lepidus)*, as does AgResearch.

[27] *More details can be found on FRST's web site (http://www.frst.govt.nz/).*

AgResearch is developing an integrated pest management system for pastoral weeds, which will assist in monitoring the performance of pest management strategies. AgResearch has also carried out research on behalf of MoH on the environmental and health impact assessments of a number of insecticides. The Institute of Environmental Science and Research (ESR) has also undertaken operational research for MoH on the southern saltmarsh mosquito, and on the feasibility of establishing snake antivenin banks in New Zealand.

Forest Research has two separate biosecurity-related divisions: Vigil, which was purchased from MAF in April 1999, and the Forest Health research group. Vigil mainly carries out forest health surveillance work, while the Forest Health research group have recently reported on the threats to New Zealand's indigenous forests from exotic pathogens and pests (Science for Conservation 142, DoC), and reported on the ongoing eradication attempt on Dutch elm disease in the Auckland area. Forest Research has also been involved in carrying out a survey of wood packaging in containers.

Landcare Research is developing a spatial model for assessing biosecurity risks in New Zealand ecosystems. A Landcare Research-led consortium *(Invasive Invertebrates in Natural Ecosystems)* comprises two strands of research. The first, *Risk Profiles for Biosecurity Decision-making*, is focused on the development of methodologies and tools for identification, categorisation and prioritisation of risks to New Zealand, in order to assist biosecurity agencies in risk-based strategy, policy, operation and surveillance. The tools being developed have been formally brought together in BIOSECURE – a spatially explicit model for prediction of the establishment and impact of alien species.

NIWA has been involved in research on Undaria, toxic algae, fish diseases and hull fouling organisms, and has compiled information on adventive marine species in New Zealand.

In addition to MAF-funded research, particular industries in the primary production sector fund targeted research into pests and diseases likely to have economic impacts on their business. AgResearch, for example, has provided research and scientific support for the agriculture sector. Forest Research and HortResearch have similarly provided a research capability for the forestry and horticultural sectors. In the environmental and health areas, which are primarily concerned with the public good aspects of biosecurity, research is generally only funded by public sector agencies.

5.7 A Biosecurity research strategy

In 1998 MoRST produced a document *Managing a Leaky Border: Towards a Biosecurity Research Strategy.* This document, and its follow-up, *Towards a Biosecurity Research Strategy in New Zealand*, prepared for MoRST on behalf of the Biosecurity Council (2000b), contains a useful framework for the types of biosecurity research needed in New Zealand. There is evidence from the types of research now being carried out[28] that these reports are having some influence.

In late 1999 the Biosecurity Council produced a paper entitled *Draft Biosecurity Research Strategies for New Zealand*. This paper has since been developed further into a policy document released by the Biosecurity Council (2000a) titled *Biosecurity Research Areas for New Zealand*.

In June 2000, following the release of the New Zealand Biodiversity Strategy, the Government decided to develop a Biosecurity Strategy (see section 8).

The proposed Biosecurity Strategy needs to incorporate and build on the information contained in each of the previous research strategy documents, clarify the frameworks and processes for prioritising biosecurity research carried out by all biosecurity agencies, and generally set the scene for all future biosecurity-related activities.

[28] *See section 7, and the FRST web site (http://www.frst.govt.nz/).*

5.7.1 Research and the Biosecurity Council

As discussed in the section on the Biosecurity Council (see section 3), it is important that the Council is involved in the co-ordination of biosecurity research.

With so many government agencies, Crown research institutes and private research organisations involved in biosecurity research, there is potential for overlap and duplication, but also opportunities for collaboration in some areas (eg assessing risks to both exotic plantation and indigenous forest health). It is important for all agencies, particularly those with operational responsibilities for biosecurity, to be aware of research undertaken in the past, the projects currently underway, and those proposed for the future. Co-ordination of this information by the Biosecurity Council ensures that all agencies are aware of research in the biosecurity arena.

Biosecurity would benefit from a greater level of collaboration between biosecurity research organisations, and between research funding agencies, to ensure that research across relevant sectors achieves a higher level of synergy and effectiveness. The Biosecurity Council needs to take a lead role in achieving this goal, particularly with respect to biosecurity risks to indigenous flora and fauna.

5.8 Information sharing

Effective biosecurity risk management relies heavily on good, accessible information.

MAF's National Plant and Animal Reference Laboratories are key sources of information – the 'key technical heartland' (Upton, 2000) – as are Crown research institutes such as Landcare Research and Forest Research, and other science/research organisations such as the Cawthron Institute, which hold databases of information that may be beneficial for biosecurity management in both the public and private sectors.

The utilisation of routinely collected raw data and the processing of it to feed into decision-making is crucial, particularly when applying a multiple-agency approach to an issue as important as biosecurity. Many agencies and research organisations are collecting information for their own needs, some of which may be useful to other agencies. Information fragmentation among various agencies and Crown research institutes is cause for concern. There is a need to better co-ordinate and share information in order to make efficient use of it, and to improve biosecurity decision-making.

A valuable source of information is the inspection information being collected at the border by MAF Quarantine Service and reported in its Annual Statistics reports. This information can act as an early warning system and an indication of trends, as well as providing feedback into biosecurity policy review and development. It is important that information collected by MAF Quarantine Service is used by MAF Biosecurity Authority to review policies and priorities for border control and post-border risk management strategies.

Comments received during the course of this investigation suggest that the competitive environment between Crown research institutes and other research providers is creating inefficiencies in information collection, storage and use, and discouraging collaboration between them. In one case, a Crown research institute, which maintains a database on plant diseases and pests, was contracted by MAF to validate the database of another. MAF advise that it undertakes validation procedures for all data entered into key databases, such as the Plant Pest Information Network (PPIN) database.

In relation to forests, there was criticism that some parts of the country are more intensively monitored for new pests and diseases than others, and we were told that, in some cases, different protocols (eg horticultural rather than forestry) or methods of surveillance are used.

The proposed Biosecurity Strategy needs to address information blockages and inefficiencies created by the construction of a competitive research infrastructure, particularly where they are likely to affect biosecurity outcomes.

5.8.1 Ownership of and access to information

During the course of this investigation, our attention was drawn to a MAF-initiated change to a service delivery contract which effectively required the research organisation to gain the consent of the relevant chief technical officer (CTO) prior to publication or release of any information resulting from that contract. MAF pointed out that this clause relates to ownership of intellectual property and was added to all MAF's new service delivery contracts. It is important that MAF's service delivery contractual clauses, intended to clarify intellectual property ownership, do not interfere with the need to share information for the benefit of better decision-making and achieving biosecurity outcomes.

5.8.2 Lack of information

Uncertainty due to the lack of information about biosecurity risks, particularly consequences for indigenous flora and fauna, is a continuing problem. In some cases it may be possible to assess the likelihood of an incursion, but the consequences for both productive and indigenous plants may be unclear because of the lack of, for example, host testing. Research commissioned by MAF Biosecurity Authority on gypsy moth host testing of New Zealand native plant species (Nothofagus species) was completed in November 2000.

5.9 Biosecurity – future environmental management needs

It is clear from the evidence gathered during this investigation that pressures on New Zealand's biosecurity system to cope with existing and new pathways for exotic pests and diseases are increasing. Some of the factors that contribute to these pressures include:

- increasing volumes of goods (including mail) and people arriving in New Zealand, and decreasing travel times
- increasing sources of goods, people, pests and diseases that are destined for New Zealand
- increasing numbers of entry points for goods and people coming into the country (eg via private yachts into provincial ports)
- the manner in which goods are carried (eg containerisation)
- the nature of the goods and their ability to carry pests and diseases
- the lack of awareness or consideration of New Zealand's biosecurity requirements
- uncertain risks created by new trade links and routes, and 'new' pests and diseases.

Biosecurity preparedness and response to these pressures needs to be in the form of:

- measures to prevent the likelihood of harmful organisms being introduced and becoming established
- techniques to improve the detection of harmful organisms
- monitoring of pathways for harmful organisms, to enable appropriate strategies to be developed
- disinfestation technology for application at the border
- surveillance of harmful organisms in New Zealand to assess their spread and impact
- treatment methods to eradicate or control harmful organisms post-border
- an effective decision-making process that enables risks to be assessed, consultation to take place, priorities to be set and action to be taken without unnecessary delay
- capacities within biosecurity agencies to manage biosecurity risks effectively, including risks to indigenous flora and fauna, biodiversity and ecosystem health.

Green (2000) discusses system needs against future biosecurity threats to the marine and terrestrial environments. Among the issues raised in that paper are marine invasive species, terrestrial invasive species and animal invasives.

5.9.1 Marine invasive species

New Zealand's biosecurity efforts in the marine area have not been commensurate with the threats we face. In part this is due to the practical limitations of being able to prevent, detect or control the spread of unwanted marine organisms. But there are measures that can be taken to reduce the risks and improve our vigilance of marine biosecurity threats.

Ships' ballast water and hull fouling are the major pathways for invasive species that threaten our marine environment. New Zealand is the only country to have mandatory controls on ballast water discharge. Other countries, such as Australia and the US have mandatory reporting, but New Zealand requires ships to gain permission before discharging ballast water. Exemptions are allowed where there are issues of ship safety or the vessel is not capable of exchanging ballast in mid-ocean.

MFish, in conjunction with MfE, is in the process of developing hull de-fouling (cleaning) regulations under the Resource Management Act 1991.

Although New Zealand has an import health standard covering ballast water discharges, research is needed into technical solutions to the treatment of ballast water while ships are in transit between countries. This needs to be raised by New Zealand through international organisations such as the International Maritime Organisation (IMO).

MFish has produced public information leaflets to alert people to invasive marine species, such as the northern Pacific seastar.[29] While such information is important and necessary to improve public awareness and vigilance, pressures created by these and future marine pests may require a greater effort from the shipping industry, in particular, and other boat owners in general, to avoid being the pathway by which such organisms arrive and spread throughout New Zealand's coastal waters.

Regional councils, who have resource management responsibilities for the coastal marine area, have a role to play in maintaining ecologically viable populations of indigenous marine species. Through their Regional Coastal Plans, regional councils can control the introduction or planting of exotic plants in on or under the foreshore or seabed within the coastal marine area, and control the discharge of contaminants, including hull-fouling organisms scraped from ships.

Regional councils can also contribute to local public awareness of marine invasive species through their environmental education programmes and State of the Environment reports.

[29] *See the MFish web site:http://www.fish.govt.nz/sustainability/ballast/pests/index.html.*

5.9.2 Terrestrial invasive species

As discussed earlier (section 3.5.1), there is already evidence of increasing pressure on the biosecurity system caused by the illegal importation, by mail, of exotic plants. Some of these plants may be new to New Zealand, brought in by people who are unaware of or who have chosen not to go through the HSNO Act approval process.

Weed plant incursions are problematic because they:

- are less likely to be spotted by the untrained eye
- have a greater chance of becoming established across a wider area
- are less likely to emerge near major entry points such as ports and airports
- are more likely to be found across a wider variety of places
- do not require urgent response, but long delays increase the costs of control
- involve both central government and regional councils in their control.

These concerns lead to the conclusions that:

- the effectiveness of the HSNO Act process to assess the weediness of new plants needs to be reviewed
- the surveillance of weeds and the pathways by which they are distributed (eg road verges, railway lines, degraded lands) needs to involve biosecurity agencies in central and local government, with the co-operation of land owners
- biosecurity agencies and science/research providers need to share information and enable their weed databases to be accessible
- public awareness campaigns need to be developed to discourage illegal importation of new and weedy plants.

5.9.3 Animal invasives

Increasing containerisation of imported goods, the low rate of inspection of containers, and the transport of them within New Zealand create risks to indigenous biodiversity, flora and fauna, and production systems if they contain animal pests. The discovery of snakes in containers of used car batteries from Australia in separate incidents during 2000 resulted in a great deal of publicity about these particular breaches of biosecurity. Scorpions have also been found in packaging.

Inspection of shipping containers is labour-intensive and time-consuming. Delays caused by inspections create costs for port companies, in terms of providing storage space and inspection facilities, and for importers. Exporters are best placed to deal with internal treatment of containers before the containers are closed, and obtaining appropriate certification that such treatment has been carried out. The problem of external contamination may be best dealt with by removing the problem, ie developing techniques to decontaminate all six sides of containers as they are off-loaded from ships.

There are also concerns about capacity issues within biosecurity organisations caused by an erosion of skills in certain scientific disciplines (eg systematics[30]).

[30] *The branch of biology that deals with classification and nomenclature.*

6.1 Introduction

Issues regarding the allocation of costs and benefits, and the economic principles of cost allocation, are discussed in a separate background paper (NZIER, 2000).

Managing biosecurity risks to indigenous flora and fauna is generally regarded as a 'public good', along with other aspects of biosecurity that provide benefits for society as a whole rather than just private individuals. Public good aspects of providing a biosecurity system are recognised by the Government in its funding for biosecurity. The entire Votes: Biosecurity, for all biosecurity agencies in 2000/01, is $103,458,000.

Biosecurity measures such as border controls, surveillance and response capabilities have the characteristics of an economic public good in that they are:

- non-rival in consumption: the service provided by biosecurity is such that one person's use does not detract from that available for others to use
- non-excludable in consumption: the service is such that it is impossible to exclude non-payers from the benefits obtained by paying subscribers (the 'free-rider' problem) (NZIER, 2000).

In practice, though, not all biosecurity measures are necessarily in the public good, and there is a case for distinguishing public good from other benefits, and thus the recovery of costs from the relevant sectors.

There is a strong case for some requirement on primary producers and other beneficiaries from the system to pay for some level of biosecurity protection, and for importers to pay for some element of biosecurity levy for increasing the risk to producers and the environment. But this argument is complicated by the fact that there is overlap in the benefits of biosecurity between private sector interests, such as those parts of the service industry that derive benefits from indigenous flora and fauna (eg ecotourism), and those of the public sector. In a broad economic sense, New Zealand is taking private risks with public externalities, but there is also a lack of risk transparency between private sector interests.

6.2 Cost-benefit models

In the context of cost-benefit analysis in New Zealand, there is little evidence that economic valuation of non-market goods and services is being considered outside an academic setting (Clough *et al.*, 2000). There are no methods and systems to measure the state of the nation's natural heritage assets (conservation of indigenous biodiversity), which is, in turn, stalling the specification of measurable conservation goals and recognition of the most cost-effective conservation projects (Stephens, 1999). The usual method of identifying public preference is through the political process, expert assessment or public polling. It is, however, now widely accepted in the literature that the economic valuation of non-market goods and services such as conservation management is acceptable economic practice, and necessary in order to improve decision-making regarding the allocation of resources.

NZIER (2000) draw attention to several different approaches, such as cost-benefit models (CBM), cost effectiveness analysis, cost utility analysis, multiple criteria analysis, the precautionary principle, and safe minimum standards.

Two of the inherent problems with CBM are the period of time considered and the discount rate that is appropriate. Portney and Weyant (1999) raise a number of questions when considering long-term projects or investments:

- Should projects whose effects will be spread out over hundreds of years or more be treated simply as 'longer versions'" of projects whose principle effects extend to no more than, say, 30 or 40 years?
- If the answer to the above question is 'yes', what is the appropriate way to determine the discount rate to be used?
- If projects with significant intergenerational effects are to be valued differently, how should this be done? Should benefits and costs in the distant future not be discounted at all, or at a different rate?
- Perhaps more fundamentally, is it appropriate to use cost-benefit analysis at all in decision-making on such issues?

In considering environmental values when developing CBM, the difficulties in gaining an accurate reflection of value are well documented. Portney and Weyant (1999) raise the following:

> *Consider a policy change for which all of the benefits and costs will be felt immediately. Even if the benefits exceed the costs by a considerable margin, we might reasonably object to the project. This would be so if, first, all the benefits go to the richest five families in the country while all the costs fall on the poorest five, and second, for institutional or other reasons there is no way to compensate the losers out of the gains of the winners.*

The relevance of this statement is that it is most likely that there would be great difficulty in compensating losers from biosecurity mishaps, let alone extract the compensation from those who have caused the biosecurity mishap, given that the costs are likely to be very large and apportioning blame very difficult. There is, therefore, a need for methodologies that consider the full consequences of biosecurity decision-making and risk-taking, as well as the development of signals to individuals and organisations of the biosecurity risks they are taking.

6.3 Biosecurity beneficiaries and risk exacerbators

Table 1 lists the beneficiaries and risk exacerbators of biosecurity.

Table 1: Beneficiaries and risk exacerbators of biosecurity

Use beneficiaries	Non-use beneficiaries	Risk exacerbators
Exporters	Public health	Importers
Commercial farming	Ecosystem services	Tourists
Horticulture industry	Indigenous biodiversity	Primary industries
Forestry industry	Future generations	Transporters
Fishing industry	Community ecological amenity health	
Commercial animal breeders		
Future generations in these industries		
Tourism industry		

Biosecurity is a compliance cost for most importers (producers or traders). As risk exacerbators (those who increase exposure to biosecurity risk), importers have little incentive to contribute to the costs of biosecurity. For exporters (producers or traders), biosecurity has varying levels of importance and benefits, depending on the risks to their production systems and hence their products, and the value of export markets.

Goods carriers and distribution organisations are also risk exacerbators. Biosecurity clearance requirements impose costs and delays on this group and on ports, although ports also benefit, in terms of export trade, in having biosecurity controls in place to meet export market requirements.

Travel and tourism interest in biosecurity is mixed – the industry is a beneficiary, but the travellers are risk exacerbators. The recent trend towards establishing international flights to smaller regional airports is an example of the expanding pressure commercial interests in travel are having on biosecurity management in New Zealand. Tourists bring themselves and any attached unwanted organisms into our primary production and indigenous ecological areas. In effect, they are a streamlined conduit between foreign countries and our national parks. The qualities New Zealand possesses make it a unique tourism destination, and to a large extent the success of the sector relies on our native flora and flora maintaining its biological integrity and health. This situation creates a dilemma for those individuals or organisations who manage areas of New Zealand landscape that attract overseas visitors and rely on the maintenance of ecological health to retain the appeal to tourists.

The main private sector beneficiary of biosecurity is primary production. Some primary producers, like agriculture and forestry, have extremely well-developed global information networks that allow transfer of relevant information on potential commercial productivity impacts. Many of the commercially productive species in New Zealand are common to other countries, and so an international knowledge of the susceptibility of these species to pests and diseases has been built up.[31] This can and has been capitalised on by New Zealand, which is at some distance from many of the threatening organisms that reduce productivity and add costs.

Trends in land use, with an increase in the variability of animal and crop types, result in increasing pressures on border control to keep a greater number of pests out. Furthermore, an expansion in the variability of export produce from New Zealand increases the range and amount of export assurance verification required.

Recently established primary production industries may have less established capabilities for determining their relative biosecurity risks.

[31] *It should be noted, however, that some organisms that cause little problem in their natural environment could be quite damaging in plantations in a different country. For instance, Dothistroma pini causes little damage in its native range, but is one of the most damaging fungi of Pinus radiata plantations in many parts of the world (Lindsay Bulman, Forest Research, pers. comm., October 2000).*

6.4 Cost allocation – an exacerbator/ beneficiary model and levy

In New Zealand there has been discussion and movement towards an exacerbator/beneficiary model for biosecurity, recognising that there are those who contribute to increased biosecurity risk, and those who have an interest in reducing or eliminating that risk. This concept has strong parallel arguments with those contained in the Resource Management Act, which requires individuals and organisations to pay for consent acquisition and to put resources into avoiding, remedying and mitigating the effects of their activities.

This model has strengths and weaknesses. Its primary strength is that it acknowledges private benefit in addition to the public good component of biosecurity. Its weaknesses include the difficulty in identifying exactly who the exacerbators and beneficiaries are and what their liabilities are, and determining an appropriate level of contribution from each towards the total biosecurity infrastructure.

If a type of exacerbator/beneficiary levy payment is established, there is still the problem of determining the probability of a biosecurity incursion occurring and the cost of the consequences. These factors are variable and make it difficult to estimate a levy amount payable. Another consideration is the need to develop a method of implementing a levy that creates an economic incentive to increase biosecurity performance through modified behaviour and technological advancement. Individuals' private and immediate motives may not necessarily match the long-term interests of the country as a whole, particularly in relation to the protection of indigenous flora and fauna. It is, therefore, necessary to encourage support for, and compliance with, the biosecurity system through increased awareness of its importance to New Zealand.

Despite its weaknesses, the exacerbator/beneficiary model is the preferred one from an environmental management standpoint, as long as it incorporates distinct private and public sector contributions and maintains a central government responsibility and capacity, particularly for pre-border and border activities. This model recognises the increasing threat to natural ecosystems and allows for those who increase the risk to contribute to alleviating that risk. There will never be a final correct allocation of these costs, but this weakness should not be a reason to delay the implementation of the funding model.

6.5 Other incentives

An attempt to create an incentive-based approach through the allocation of costs among the private sector, the Crown and producers was outlined at the New Zealand Agriculture and Resource Economics Society Conference 2000 (Crump, 2000). The paper by Crump (2000) analysed the costs of each biosecurity output, and outlined the beneficiaries of each. In summary, the paper identified that:

- policy advice, biosecurity enforcement and diagnosis all benefited society at large and so should be funded by the Government
- import health standards, export assurance standards and surveillance (with the exception of the Crown-owned estate) are essentially a club good[32] and therefore a flat fee for each imported product should be applied
- vessel clearance, costs of compliance and clearance of goods should be transferred to the importer into New Zealand or the exporter from New Zealand, with the consumer ultimately paying
- incursion response could be funded through levies on a sector basis (assuming a pest or disease impacts only on a distinct sector).

The paper concluded that there are opportunities for the Crown to recover some costs that are not recovered at present. However, there are several areas of contention with these conclusions. When levies are set for the purpose of collecting from beneficiary sectors, to what extent does each sector have a say in its own level of, for example, surveillance? The Varroa bee mite is a good example where the consequence of a small industry funding surveillance at a level that it can afford may not take account of the unforeseen consequences outside that industry.

At present there are confused incentives for importers to comply with biosecurity requirements. For example, a shipping line pays a biosecurity fee to MAF, but then spreads that cost among its importer customers. While this cost is likely to be passed on to the final consumer, the exacerbation is not truly cost-targeted. As a result, the incentive is lost on importers to be more cost effective in reducing the risks they impose.

[32] *Club goods (or services) occur when groups of consumers share ownership of that good (or service).*

A problem still exists from some sectors being able to ignore risks (costs) they impose on others. An example is the threat that shipping poses to the marine farming industry. The fledgeling aquaculture industry has developed a sophisticated system for monitoring water quality and invasive organisms, yet they have little ability to control the risk of attack by harmful exotic marine organisms that may arrive on vessels' hulls or in ballast water. As a result, the aquaculture industry is highly vulnerable to marine invasive species. Improving the information and understanding of such risks may enable an incentive programme to be established that encourages a reduction in those risks, by both the exacerbator industry and the beneficiary industry.[33]

In areas of biosecurity management that involve technology and technically specialised skills, such as emergency response, surveillance, detection and diagnostics, there is considerable scope for the consideration of an adaptive management approach, ie developing new methods as they are actually applied. Given that biosecurity pressure is increasing over time, it is important that we drive continuous technological, technical and managerial improvement. Consideration must be given to the benefits of 'learning by doing'. New pests and diseases will continue to arrive, and decisions to eradicate or control need to take into consideration the future benefits of developing greater skills and technology from carrying out the activities, even if the outcome is uncertain on the basis of current knowledge. The value of 'learning by doing' needs to be given serious consideration in biosecurity response decision-making.

[33] *MFish reports that information to shippers on biosecurity risks is beginning to pay off. Shippers were requested not to transfer ballast water from the area affected by the Gymnodinium catenatum bloom to unaffected areas. So far, the bloom has not spread into the Marlborough Sounds.*

6.5.1 Willingness to pay versus willingness to accept

On a more general level, it is often assumed that society's 'willingness to pay' for an economic gain (eg increase in value of trade) is equivalent to society's 'willingness to accept' a loss (eg through a failure in the biosecurity system). However, as pointed out by Knetsch (2000):

> *The empirical evidence is instead that people commonly value losses more, and often two to four times more, than commensurate gains – a difference often referred to as loss aversion, an endowment or reference effect.*
>
> *The distinction is important because a positive change that results in reducing a loss will normally be more than one that provides a gain, and a negative change which imposes a loss will be far more aversive than one that results in just foregoing a gain.*

In the environmental context:

> *Too few resources will be devoted to avoiding environmental and other forms of community deterioration as the efficiency of alternative allocations will be biased against avoiding losses (Knetsch, 2000)*

This argument raises some fundamental questions about decisions on public resource allocations that are made as if they were simply accumulations of private purchase decisions. It also raises major questions about the balance of public and private expenditure invested in biosecurity, and what minimum standards of biosecurity need to be set.

The empirical evidence is that biosecurity has high public worth (because of environmental and community values) and that its main objective must be to prevent losses.

6.6 Private and public sector contributions to biosecurity

In summary, the development of biosecurity in New Zealand has grown from the realisation that we have a distinct commercial advantage in maintaining a relatively disease- and weed-free primary production sector. Protecting that advantage has ongoing costs, and they are increasing because of the increase in pressure at the border, which in turn is due to expansion in the amount of trade we carry out, the variety of countries we trade with, the variety of goods we trade in and the speed with which they are delivered. This also applies to our tourism industry, which is expanding in several ways, such as points of entry. There is, therefore, a recognised distinct value to elements of the private sector in maintaining or increasing our level of biosecurity protection, making it logical that they contribute to the cost of biosecurity, in partnership with the Government.

The wide variety of biosecurity interests, both within the private sector and across private and public interests, creates a situation that could provide opportunities for collaboration and 'learning by doing'. While there are inherent areas of unique- or self-interest within each group, the overriding objective in protecting New Zealand's borders from alien invaders should provide enough impetus for the formation of better partnerships. A platform that allows this approach to develop has yet to evolve, but the fostering of co-operation and mutual contribution could take the New Zealand biosecurity system to the next level of development. Introducing specific contributions from the private sector for biosecurity management at the national level is a key step. However, as mentioned by Budd (2000):

> *The Varroa mite is an example of the private sector selecting a sub-optimal level of self-regulation, which has large national economic consequences.*
>
> *It is also an example of the shift in government philosophy. After a decade of expensive incursion responses and a declining reliance on the primary sector in the economy it is likely that the decisions, justifications and arguments around who should pay for the Biosecurity systems will hinder the future development of the Biosecurity Strategy and paralyse the response activities for new and uncategorised pests.*

This prediction should act as a warning against attempting to shift any biosecurity responsibilities away from central government. Financial contribution by the private sector is a necessary step towards achieving appropriate funding levels, but the core biosecurity responsibility needs to stay at a national level.

7.1 International agreements relating to biosecurity and signed or ratified by New Zealand

International obligations have had a significant influence on New Zealand's biosecurity strategies to date (Budd, 2000). New Zealand has signed or ratified a number of international agreements, both bilateral and multilateral, that directly or indirectly support the establishment of national biosecurity management systems. These include:

- WTO Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement)
- WTO Agreement on Technical Barriers to Trade (the TBT Agreement)
- General Agreement on Tariffs and Trade (GATT)
- International Plant Protection Convention (IPPC)
- Convention on Biological Diversity (CBD), and the Cartagena Protocol on Biosafety
- Ramsar Convention on Wetlands
- Framework Convention on Climate Change and Kyoto Protocol
- Convention for the Protection of World Cultural and Natural Heritage
- Plant Protection Agreement for the South-East Asia and Pacific Region
- Closer Economic Relations Agreement with Australia (biosecurity influenced by harmonisation of standards such as food labelling)
- MARPOL, the International Convention for the Prevention of Pollution from Ships
- UN Convention of the Law of the Sea (UNCLOS).

There are also several international strategies relevant to biosecurity that are under development, such as the Strategy on Invasive Species by IUCN (the World Conservation Union), and the South Pacific Regional Environment Programme (SPREP) regional invasive species strategy.

Other international organisations that set standards for safe international trade include:

- Codex Alimentarius Commission (CAC)
- Interim Commission on Phytosanitary Measures
- Office International des Epizooties (OIE).

The World Health Organization (WHO) and the Food and Agriculture Organization (FAO) provide further technical assistance.[34]

7.2 Key multilateral environment agreements

There are a number of multilateral environmental agreements (MEAs) that are relevant to biosecurity, including the Convention on Biological Diversity and the Cartagena Protocol on Biosafety.

7.2.1 The Convention on Biological Diversity (CBD)

The objectives of this MEA, which has been in force since December 1993, are to implement global objectives in conserving biological diversity, sustainable use of the components of biological diversity, and equitable sharing of the benefits arising from the utilisation of genetic resources.

The CBD creates an international structure to support national biodiversity strategies and to promote continued international co-operation. Structures include a permanent secretariat; a subsidiary body for science, technical and technological advice; and a clearing-house mechanism to exchange and share information in support of scientific and technical co-operation. The CBD has designated the Global Environment Facility as its funding mechanism to aid developing countries. Parties are required to develop national biodiversity strategies, plans, or programmes 'to conserve and sustainably use and manage biodiversity' (NZ Government, 2000). The Convention also imposes obligations on member countries to co-operate on biodiversity matters (Downes, 1999).

[34] *WTO, SPS Committee, Review of the Operation and Implementation of the Agreement on the Application of Sanitary and Phytosanitary Measures, G/SPS/12, March 1999.*

Article 8(g) and (h) are the parts of the Convention most pertinent to biosecurity, requiring each contracting party, as far as possible and as appropriate, to:

(g) establish or maintain means to regulate, manage or control the risks associated with the use and release of living modified organisms (LMO) resulting from biotechnology which are likely to have adverse environmental impacts that could affect the conservation and sustainable use of biological diversity, taking into account the risks to human health;

(h) prevent the introduction, control or eradication of those alien species which threaten ecosystems, habitats or species.

Article 8(g) relates primarily to the functions of ERMA under the HSNO Act, and 8(h) is met by New Zealand's biosecurity system.

The CBD addresses the direct link between trade and the environment, the trade of biological resources and the increasing pressure to exploit wildlife and conservation habitats. However, the CBD recognises the potential for this economic pressure to translate positively into a custodian approach, where a proportion of the benefits from capitalising off a particular species can help to distribute benefits equitably and create incentives for conserving biodiversity. The CBD also seeks to address the indirect effects that trade creates through transportation (eg pollution) and provision of infrastructure (eg land use issues associated with the construction of roads and ports).

7.2.2 Cartagena Protocol on Biosafety

This is a Protocol to the CBD. The text of the Biosafety Protocol was agreed in January 2000 and the Protocol was opened for signature in May 2000. It will come into force when 50 countries have ratified it.

The Protocol addresses the safe transfer, handling and use of living modified organisms (LMOs) that may have an adverse effect on biodiversity, and takes into account risks to human health, with a specific focus on transboundary movements. Governments will advise whether or not they will accept imports of agricultural commodities that include LMOs through an internet-based Biosafety Clearing House. Shipments of commodities that may contain LMOs are to be clearly labelled.

7.3 The environmental implications of trade

The creation of the WTO and the development of a philosophy of trade liberalisation, sometimes referred to as 'free trade', has created a particularly large and complex international situation that has sparked intense interest from many groups, including environmental non-governmental organisations.

The extent to which trade liberalisation either harms or favours the environment depends to a large degree on how well trade and environmental policies are integrated. Where a 'balance' between the two policies is achieved, trade will support the environment; where policies are conflicting or contradictory, the environment stands to be harmed by the removal of barriers to trade (Downes, 1999).

Critics of trade globalisation fear that the environment could be the loser if WTO rules clash with the terms of MEAs.[35] It is possible that even trade measures agreed in MEAs, and applied between two parties to those agreements, could still be taken before a WTO dispute panel. To date, WTO/CTE (Committee on Trade and the Environment) analysis has identified areas where conflict may arise, but has done little or nothing to resolve the issues to the satisfaction of both trade and the environment (Downes, 1999). To understand better how to minimise negative impacts on the environment, the United Nations Environment Programme (UNEP) is adapting its environmental impact assessment methodologies to address the effects of liberalisation and other trade-related policies. UNEP is also promoting the concept of integrated trade and environment policies on the basis that 'preventing environmental damage is cheaper than fixing it later, and some environmental damage is irreversible'.[36]

[35] *The Ministry of Foreign Affairs and Trade (MFAT) consider the potential conflict between WTO provisions and MEAs to be limited, and that questions are only likely to arise where the provisions of an MEA are unclear as to the action they mandate.*

[36] *Statements from UNEP's Executive Director, Klaus Toepfer (see http://ens-news.com/ens/oct2000/2000L-10-16-01.html).*

The major concerns that environmentalists have about trade have been outlined in the literature and can be reduced to four main points:

1. In promoting economic growth, trade may damage the environment through the unsustainable use of natural resources, and pollution emissions.
2. MEAs may contain trade measures that are illegal under WTO rules and, correspondingly, market access conditions of these rules may restrict the ability of countries to implement domestic environmental regulations.
3. Countries operating low environmental standards will create pressure for other countries to lower their environmental standards.
4. Freer trade, as being implemented through the WTO, may prevent nations from using trade restrictions to protect their environment.[37]

7.3.1 The dominance of trade over other interests

As outlined above, environmental interests are concerned at the different approaches taken by WTO rules compared to MEAs, and the potential for such differences to lead to a clash of objectives. Unlike the WTO, which deals with issues under a single overarching framework, MEAs tend to deal with specific environmental issues. This fragmentation has been cited as leading to each environmental issue being dealt with as an isolated case so that it is perceived to be less important than overall trade issues (Guruswami, 1998).

There is a values-based argument that New Zealand should support 'safe trade' as opposed to 'free trade' in an attempt to prevent the permanent alteration of indigenous ecological habitats through the invasion of exotic pests and diseases. That is not to say that trade liberalisation is categorically unfavourable, but that it may not be completely in the interests of New Zealand's indigenous biodiversity and ecosystem health.

What affects this position is that New Zealand, as a small, isolated island nation with unique indigenous biodiversity, is in a minority position at a global level and at risk of other nations not appreciating our biosecurity interests. New Zealand's uniqueness, in terms of its distinct ecology and geographical situation, highlights the importance for us to seek our own solutions to biosecurity issues, as there is likely to be less emphasis on biosecurity among those trading nations that do not have our features.

[37] *Adapted from Cole, 1999.*

7.3.2 New Zealand international biosecurity programmes[38]

New Zealand is involved in a wide range of international biosecurity programmes through the New Zealand Official Development Assistance (NZODA). New Zealand delivers assistance on biosecurity via regional organisations such as the South Pacific Regional Environment Programme (SPREP) and the Secretariat of the Pacific Community (SPC), and via other NZODA sectoral bilateral, regional and multilateral programmes. Examples include the following:

- NZODA is contributing NZ$500,000 over three years to a Regional Avifauna and Invasive Species Project under its Pacific Initiative for the Environment (PIE), implemented by SPREP.
- NZODA is the major donor for a Pacific Regional Workshop planned for March/April 2001 on Biosecurity. This workshop will be run as a joint venture between SPREP, SPC and the Forum Secretariat. The agenda will place strong emphasis on building the capability of Pacific island countries to develop border controls and risk assessment and risk management infrastructures.
- New Zealand has contributed, and will continue to contribute, to UNEP's Voluntary Trust Fund to facilitate the participation of developing countries in Convention on Biological Diversity processes. For example, New Zealand is contributing NZ$30,000 to this Voluntary Trust Fund to assist with Pacific Island participation in the First Meeting of the Intergovernmental Committee on the Cartagena Protocol on Biosafety. Another NZ$30,000 has been earmarked for the Sixth Subsidiary Body on Scientific Technical and Technological Advice.
- New Zealand has supported, and is continuing to support, plant protection and quarantine services in the Pacific island region through SPC's Plant Protection Service (SPC-PPS). For the 2000/2001 financial year, NZODA has contributed NZ$550,000 to SPC-PPS to support components of its Pest Management in the Pacific Project.
- Financial assistance has also been delivered via bilateral quarantine projects in, for example, Vanuatu and the Solomon Islands.

[38] *Information provided by the Ministry of Foreign Affairs and Trade (MFAT), Wellington.*

The Invasive Species Specialist Group of IUCN located at the University of Auckland was one of the implementing agencies involved in the development of the 'Action Strategy for Nature Conservation in the Pacific islands region, 1999-2002'. The strategy was produced by SPREP on behalf of all the implementing agencies. Funding was provided by MFAT to IUCN to support its work in this area over three years. That three-year period is over, but NZODA has not received any further application from IUCN, so funding for additional work by IUCN on the strategy is uncertain at this stage.

MAF is collecting information on goods carrying harmful organisms and the source countries from which they arrive. This is intended to focus biosecurity resources on the identification of high-risk pathways. Consideration is also being given to the ports the ships and their containers or other cargo may have passed through prior to arriving in New Zealand. At present there are difficulties in discerning all the required information through the import certification and tracking processes. The information and comments on cross-border flows, obtained during the preparation of this report, stress that focusing on pathways to manage high-risk organisms is an important initiative.

7.3.3 WTO, GATT and biosecurity implications

Biosecurity, like other environmental issues, is at present strongly influenced by the international trade agreements of which New Zealand is a member. These include the WTO agreements concluded in 1994 as part of the Uruguay Round negotiations. The Uruguay Round was particularly pertinent to New Zealand as it had major connotations for agriculture and forestry.

The Agreement on Technical Barriers to Trade (TBT) seeks to ensure that technical regulations and standards, and testing and certification procedures do not create unnecessary barriers to trade. When adopting mandatory technical regulations, member countries are not to discriminate between imports of like products from different countries, or between imported and domestic products. The Agreement requires countries to apply their standards in a non-discriminatory way, and to ensure that measures are scientifically and technically justifiable and are not more trade-restrictive than is necessary to achieve their stated objectives.

The Agreement on the Application of Sanitary and Phytosanitary Measures (the SPS Agreement) deals more emphatically with rights and obligations than does the CBD, and has a well-defined system for resolving disputes between parties (Sinner and Gibbs, 1998b). The SPS Agreement allows member countries to take measures necessary to protect their biosecurity. Any such measures are required to be based on scientific principles, not maintained without scientific evidence (unless this is done on a provisional basis), and applied only to the extent necessary to protect human, animal and plant life or health. The SPS Agreement aims to harmonise SPS measures and requires member countries to, in general, base their measures on international standards, guidelines and recommendations developed by three institutions recognised by the WTO. Member countries are to avoid arbitrary or unjustifiable distinctions in the levels of protection they impose in particular situations, especially if such distinctions result in discrimination or a disguised restriction on international trade.

Relevant Articles in GATT include:

- Article XI.1: relates to quantitative restrictions, i.e. import/export/re-export certificates, and limits on volume restrictions.
- Article VIII.1: deals with the implementation of enforcement measures.
- Article XIV: refers to 'stricter domestic measures', and that there should be equivalence with international standards.
- Articles I and III: deal with the obligation to treat 'like products' in the same way, no matter what their country of origin. This is intended to avoid non-tariff barriers to trade, such as restrictions on the imports of organisms already established in the importing country.
- Article XX: outlines exceptions to GATT:
  - Article XX(b) has regard to measures necessary to protect human, animal, plant life or health
  - Article XX(g) covers measures relating to the conservation of exhaustible natural resources.

There have been a number of cases involving Articles I, III, XI:1 and XX. One commonly referred to, under Article XX(g), is the shrimp-turtle case in 1998, which prevented the US from banning imports of shrimp that had been caught by Mexican fishermen in a manner that harmed sea turtles. The Appellate Body in that case confirmed the importance of protecting and preserving the environment, but also made clear that in adopting policies aimed at protecting the environment WTO members must fulfil their obligations and respect the rights of other members under the WTO Agreement. On the facts of that case it found that, among other things, a failure to have prior recourse to diplomacy as an instrument of environmental protection policy resulted in a unilateralism that was discriminatory and unjustifiable, and that a rigid and inflexible application of the measure in question resulted in arbitrary discrimination. The US has since been working with the developing countries involved to assist them in raising their environmental standards relating to shrimp fishing.

Within the SPS Agreement there is a reference to an obligation to avoid 'arbitrary or unjustifiable distinctions' in the levels of sanitary or phytosanitary protection considered to be appropriate in different situations, if such distinctions result in discrimination or a disguised restriction on international trade. This implies that the burden of proof lies with the party who wishes to constrain trade rather than promote it. If we were doing more to control some unwanted organisms within New Zealand we could justify stronger controls at the border.

In negotiating the Biosafety Protocol, one of the most contentious issues was how to resolve the relationship between the Protocol and other international agreements, particularly the WTO Agreements. Environmental agreements are premised on the precautionary principle, whereas decisions under the WTO Agreements require 'sufficient scientific evidence' (see also section 3.5.5 on the precautionary approach). While the Protocol and the WTO Agreements are to be 'mutually supportive', the Protocol is not to affect the rights and obligations of governments under any existing international agreement.

In 1996 the WTO suggested (WT/CTE/1, 12 November 1996 para 178) that:

> *While WTO members have the right to bring disputes to the WTO dispute settlement mechanism, if a dispute arises between WTO members ... over the use of trade measures they are applying to themselves pursuant to the MEA (Multilateral Environmental Agreement), they should consider trying to resolve it through the dispute settlement mechanisms available under the MEA.*

While this suggests that the MEA process is preferable in some cases, there is no guarantee that a party will not invoke the WTO dispute resolution process where that party sees its own trade interests being affected. The WTO dispute settlement mechanism is very effective, whereas MEA dispute settlements often result in obligations that are not binding.

Biosecurity is undoubtedly the most crucial part of efforts to halt the decline in our indigenous biodiversity. The case studies in this report and in *The New Zealand Biodiversity Strategy* (New Zealand Government, 2000a) illustrate the vulnerability of New Zealand's indigenous ecosystems to invasive introduced species. This section outlines some of the work that has been done to identify the problems, and how the Government intends to address them through its Biodiversity Strategy.

8.1 The state of our biodiversity

Some of the key features of the state of our biodiversity, as outlined in the first State of the Environment Report (MfE, 1997, 9.6 to 9.154), include:

- New Zealand may have 80,000 species of native animals, fungi and plants, only about 30,000 of which have been described and named.
- New Zealand's biodiversity is more primitive in character than that of many other countries.
- In only about 700 to 800 years (about 30 generations) humans and their accompanying animals have eliminated endemic species, including 32% of land and freshwater birds and 18% of seabirds. New Zealand has a greater percentage of threatened endemic birds than almost any other country.
- Nearly 1,000 animals, plants and fungi have been identified as threatened.
- The main threats to most species include introduced pests and weeds that prey on native species, compete with them, or damage their habitat.
- Most of the New Zealand landscape is now ecologically hostile to many native species.
- Alien species (eg possums, goats and deer) threaten a third of our protected forests (1.8 million hectares).
- The historical problem is a dual legacy of habitat loss and introduced species.
- A small number of introduced crop, livestock and biocontrol species are vital to New Zealand's agriculture, horticulture and forestry industries.

- Society's responses to the pressures from alien species include:
  - more than 600 pest and weed control operations yearly by DoC
  - pest control programmes, mainly in agricultural areas, by regional councils and the Animal Health Board
  - testing and risk assessment of introducing new organisms.
- Pest and weed control, although costly, is now a necessary component of the modified New Zealand ecosystem.
- Marine species are increasingly vulnerable, despite being substantially removed from the pressures affecting the land and freshwater species.

8.2 IUCN (World Conservation Union) Guidelines

Scientists and governments now acknowledge that one of the major threats to native biological diversity is biological invasion caused by alien invasive species ('biological pollution') (IUCN, 2000).

The aim of the IUCN *Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species* is to address the inadequate safeguards, internationally, against alien species that threaten native biodiversity. The IUCN has expressed concern that, in the past, customs, quarantine and other import/export practices have developed to guard against human and economic diseases and pests, and are inadequate to deal with threats to native biodiversity.

The goal of the IUCN Guidelines is to prevent further losses of biological diversity due to the deleterious effects of alien species. The intention is to assist governments and management agencies to give effect to Article 8(h) of the Convention on Biological Diversity (see section 5).

8.3 New Zealand's Biodiversity Strategy

In February 2000, the New Zealand Government published its first Biodiversity Strategy (New Zealand Government, 2000) in response to the state of decline of New Zealand's indigenous biodiversity, and to our obligation under the Convention on Biological Diversity to develop a national biodiversity strategy.

Biosecurity is defined in the strategy as:

> *...the protection of people and natural resources, including biodiversity, from unwanted organisms capable of causing harm (p 137).*

Biological diversity (biodiversity) is defined in the same document using the definition of the Convention on Biological Diversity:

> *...the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems (p 137).*

The strategy acknowledges that our understanding of the effects of introduced species on indigenous biodiversity is limited, and that full integration of indigenous biodiversity considerations into the biosecurity management regime has yet to occur (p 80).

Biosecurity management issues raised in the strategy (pp 81–83) include co-ordination of biosecurity management, integrated border control, biosafety for genetically modified organisms (GMOs), aquatic biosecurity issues and knowledge and capacity.

8.3.1 Co-ordination of biosecurity management

There is a need for clarity about the roles and responsibilities of different agencies due to:

- the lack of fully co-ordinated objectives, policies and operating procedures among agencies
- little incentive for agencies to take the initiative to control pests that present risks to indigenous biodiversity
- insufficient priority and inadequate resources for managing unwanted organisms detected as being present but not yet widespread in New Zealand.

8.3.2 Integrated border control

There is a need for effective border control to prevent the introduction of new unwanted species. Problems include:

- the lack of resources for identifying exotic organisms that pose a potential threat to indigenous biodiversity
- the costly and, therefore, limited scope of surveillance programmes for specific pest species
- inconsistencies, both within and between agencies, in the way border control decisions are made and advice given to the Government
- few mechanisms, beyond meeting animal and plant health status requirements of other countries, to promote notification, exchange of information, and consultation on activities that are likely to adversely affect biodiversity in other countries (eg export of pest species).

8.3.3 Biosafety for Genetically Modified Organisms (GMOs)

There is a need to develop mechanisms to identify and manage the potential threat of new organisms (including GMOs) to indigenous biodiversity because:

- the development of biosafety protocols for GMOs is still in the early stages
- the role of agencies in controlling GMOs have not been fully defined (eg post-release monitoring of new organisms, and managing responses to non-intended impacts of these organisms)
- there is a low awareness of biotechnology issues generally and, in particular, to issues of biosafety and border control
- the overall risks and benefits of GMOs to biodiversity need to be assessed.

8.3.4 Aquatic biosecurity issues

There is a need to develop systems to prevent and deal with aquatic pests and weeds in freshwater and marine environments because:

- no agency has clear responsibility for, and emergency response to, aquatic weeds and animal pests
- some of the greatest risks from aquatic weeds may be from species already present but not yet widespread or naturalised (eg oxygen weed *Hydrilla*); their management currently falls outside border control and biosecurity mechanisms
- timely response to dealing with some introduced aquatic species may be affected by uncertain identity (taxonomic uncertainty).

8.3.5 Knowledge and capacity

There is a need to address significant knowledge gaps and lack of capacity, especially in relation to assessing risks. This makes the precautionary principle especially important. Problems include:

- inadequate information in most agencies to incorporate risks to indigenous biodiversity into their risk analysis and decision-making protocols
- no consistent risk assessment methodology
- a lack of fully aligned risk assessment methodologies for importing new organisms and control of unwanted organisms at the border
- poor knowledge of the potential impacts of risk goods, which creates difficulties for establishing import restrictions based on sound science with regard to WTO rules
- a lack of knowledge for assessing potential risks to indigenous biodiversity of exotic species that are already in New Zealand but are not yet widespread or naturalised
- shortfalls in the knowledge of the relationships between New Zealand's introduced and indigenous species, which cannot readily be bridged by access to overseas information
- insufficient expertise and technical capacity in aspects of biosecurity management among relevant agencies
- potential risks and benefits of GMOs, which are not well understood, and assessment systems that are not easily implemented.

The Biodiversity Strategy sets out a list of priority and other actions needed to address these issues (pp 85–87). These are listed under five objectives:

1. *Co-ordinating biosecurity management*: effectively co-ordinate biosecurity management within and across central and local government and non-governmental agencies, and clarify responsibilities for managing risks from unwanted organisms to indigenous biodiversity and important introduced species.
2. *Methods of assessing and managing biosecurity risks*: establish effective methods of assessing and managing risks from unwanted organisms to indigenous biodiversity in conjunction with those methods for introduced species.
3. *Border control*: maintain and enhance integrated border control measures as the first and most important line of defence for minimising biosecurity risks to New Zealand's indigenous biodiversity and important introduced species.
4. *Managing risks to biodiversity from new organisms*: manage the introduction of new organisms (including GMOs) in a way that avoids adverse effects on New Zealand's indigenous biodiversity and important introduced species.
5. *Managing potential pest species*: eradicate or contain introduced species that have the potential to become serious threats to New Zealand's indigenous biodiversity and important introduced species.

8.4 Biodiversity Strategy funding

In June 2000, the Government announced a funding package in its Budget to support the implementation of *The New Zealand Biodiversity Strategy* (New Zealand Government, 2000a). The Government has committed an extra $187 million over a five-year period. This includes new funding for Conservation, Environment, Fisheries and Biosecurity.

In terms of funding specifically targeted at biosecurity, the package includes:

- maintaining and restoring biodiversity through animal pest and weed control ($57 million)
- protecting marine biosecurity ($9.8 million)
- enhancing New Zealand's biosecurity capability through development of a New Zealand Biosecurity Strategy and assessing biosecurity risks to indigenous flora and fauna ($2.6 million).

8.4.1 Animal pest and weed control

The extra funding represents a 150% increase in invasive weed surveillance and control, and enhanced control of browsing pests, including possums, deer and goats.

8.4.2 Marine biosecurity

The extra funding is to be used for developing information and management systems to enhance New Zealand's marine biosecurity. This project aims to protect the marine environment from invasive marine species that could seriously affect our marine biodiversity, such as the northern Pacific seastar, the Asian date mussel, and *Undaria* seaweed.

The project is to be supported by research in the following areas:

- baseline surveys of the biodiversity of New Zealand's nine busiest ports
- the development of alternative management tools for threats to biosecurity from known sources
- the development of a risk profile of species that may arrive in New Zealand
- the identification and establishment of surveillance techniques for marine pests.

8.4.3 Biosecurity Strategy

The Biosecurity Strategy is intended to provide direction to all agencies involved in biosecurity and aims to get general agreement on areas of priority.

The strategy is to cover all aspects of biosecurity, including risk assessment, border management, and eradication and control of pests and diseases that threaten New Zealand's biodiversity.

The first two years will focus on the development of the Biosecurity Strategy through a public consultation process. The third year's funding will provide for the publication and co-ordination of implementation of the strategy, although agencies' implementation costs will need to be sought separately from the Government.

9.1 Introduction

This section outlines issues raised by several individuals consulted during the course of this review, who either represented iwi or who were identified as having a particular interest in, and a Maori perspective of, biosecurity issues. It also makes reference to comments raised in a 1998 workshop for tangata whenua on biosecurity risk management.[39] The main concerns centre around the lack of commitment to consultation with Maori, and the absence of any process for including Maori in biosecurity decision-making, particularly at central government level.

9.2 Issues

The over-arching concern among those consulted was the narrow approach to biosecurity legislation, structures and processes that appeared to be monocultural and entirely Western science-based. This is at least partly due to New Zealand's commitments to international agreements on trade liberalisation, which require scientific justification for import controls, but it also stems from the historical approach to biosecurity which focused attention on the protection of New Zealand's agricultural production and exports. However, even the relatively new system under the Biosecurity Act is regarded by those interviewed as not having brought about any tangible improvements to the consideration of Maori interests and values, or to meeting the Crown's obligations under the Treaty of Waitangi.

Among the concerns raised were matters of principle, consultation, international obligations, risk identification, risk assessment, risk treatment, monitoring and surveillance, decision-making, research, and operational issues.

[39] *Unpublished summary of discussions at the Tangata Whenua Workshop on Biosecurity Risk Management organised by the Biosecurity Council, Wellington, 8 May 1998. The views expressed are indicative only. They do not purport to be widely held views within the Maori community.*

9.2.1 Matters of principle

Biosecurity incursions can have physical effects on animals and plants, but can also adversely affect tangata whenua associations or connections with landscapes and locations, intrinsic value of biodiversity, and spiritual interests in the protection of natural resources and taonga. Biosecurity maintenance is of crucial importance to iwi and involves working within the frameworks of whakapapa, kaitiakitanga and rangatiratanga.

Maori have interests not only in protecting indigenous flora and fauna, but also valued introduced species. Cultural values should be recognised as being dynamic. This was recognised in the HSNO Act by reference to 'valued flora and fauna'. Maori are interested in being consulted on the development of policy frameworks as well as on individual cases.

The Biosecurity Act makes no reference to the Treaty of Waitangi (unlike s 8 of the Resource Management Act and s 8 of the HSNO Act). It is important to have a statutory reference to the Treaty to ensure the Crown fulfils its Treaty obligations, and to promote actions to protect iwi interests.

9.2.2 Consultation

The only statutory requirement to consult specifically with Maori on biosecurity matters is in relation to the preparation of a proposed regional pest management strategy (RPMS), during which a regional council is required to consult with the tangata whenua of the area who may be affected, through iwi authorities and tribal runanga (s 73(1) of the Biosecurity Act). In relation to proposed national pest management strategies (NPMSs), one of the prerequisites is that the Minister proposing the NPMS is of the opinion that the organism to which the strategy relates is capable of causing serious adverse and unintended effect on one or more of a number of things. One of these is 'the relationship of Maori and their culture and traditions with their ancestral lands, waters, sites, wähi tapu, and taonga' (s 57(1)(c)(v) of the Biosecurity Act). There is no requirement to consult specifically with Maori on the development of import health standards (s 22 of the Biosecurity Act).

In February 2000 MAF Biosecurity Authority released its policy statement on consultation (MAFBA, 2000f) (ie external consultation with interested parties). The policy statement did not include specific consultation with Maori, but pointed out that a MAF-wide policy statement on consultation with Maori was to be developed.[40] Representatives of tangata whenua consulted during the PCE's review considered that consultation with Maori on biosecurity issues should be integrated into MAF Biosecurity Authority's consultation policy, not dealt with under a more general policy.

It is important for Maori that consultation occurs early, before position papers or proposals are prepared, so that those who have that responsibility gain a clear understanding of the concerns and perspectives of tangata whenua. Capacity-building (ie knowledge and competencies within agencies) arising out of consultation will eventually result in more effective iwi participation and decision-making.

9.2.3 International obligations

International agreements related to biosecurity, such as the Sanitary and Phytosanitary (SPS) Agreement, to which New Zealand is a party, base biosecurity decisions on a scientific or technical assessment of risk that may exclude specific Maori spiritual or perceptual values. Cultural and spiritual concepts that do not have a clear physical manifestation (eg matters related to whakapapa or mauri, or the spiritual effect of exotic species on the mauri of taonga or wähi tapu) would be difficult to take into account under SPS rules because of the difficulty of scientifically establishing a 'physical effect'. Despite this constraint from an international trade perspective, protection of Maori cultural and spiritual concepts should not be compromised just because of the lack of a discernible physical manifestation. Other international agreements, such as those protecting the rights of indigenous people (for example, Article 8(j) of the Convention on Biological Diversity), may be relevant in this respect.

[40] *MAF advise that its new Maori Strategic Policy Unit is developing the MAF position on Maori consultation and this will be included in MAF Biosecurity Authority's consultation policy.*

9.2.4 Risk identification

All species in an ecosystem have cultural value in terms of the connecting forces of mauri, whakapapa, mana and tapu. Species may be valued for their intrinsic place in the ecosystem as well as for their specific cultural use. Particular knowledge associated with flora and fauna is also highly valued.

The values placed on taonga are determined at a hapü and whänau level and may be specific to that hapü or whänau. It will be important to have the involvement of skilled kaumätua and kuia to help identify risks. In some cases a hapü may support an introduction of a species whereas another hapü may object to it. There needs to be opportunity for both sets of values to be discussed and addressed.

There is concern about the confidentiality and use of culturally sensitive information identifying whether flora and fauna, wähi tapu or other taonga may be affected by a biosecurity decision, and the likelihood that such information may be taken and used out of context.

A significant risk from an unwanted organism is the potential loss of traditional practices and knowledge resulting from its introduction. This has implications for the transmission of knowledge and cultural values across generations. A broad approach to the identification of risks identifies cross-species risks (ie pests or diseases that cross over to affect other species). There appears to be a general lack of scientific evidence in issues of cross-species risks.

The current systems for identification of consequences of an incursion or introduction put a lot of emphasis on utilitarian values. Spiritual and cultural impacts also need to be considered.

9.2.5 Risk assessment

In the context of Maori interests in biosecurity it is important for risk assessors to take into account:

- cumulative effects – the risks of various organisms over time, and the unknown needs of future generations
- how different perceptions of risk are weighted (eg the Maori view versus Western science principles and practice)
- all indigenous species and ecosystems have value to tangata whenua
- perceptions of risk change over time (eg depending on familiarity with the risk)
- the importance of the precautionary approach when there is a high level of uncertainty involved
- the lack of reliable scientific information on indigenous flora and fauna (particularly in the marine environment) and how vulnerable they are to harm by exotic species
- traditional knowledge held by Maori and the importance of appropriate safeguards to protect sensitive information.

9.2.6 Risk treatment

There may be conflicts between local risk treatment initiatives and national regulatory frameworks. For example, some iwi have used rähui to protect bays from the effects of ballast water discharges.

9.2.7 Monitoring and surveillance

Local environmental knowledge held by Maori is valuable in the monitoring and surveillance of unwanted organisms and their effects, and helps to indicate where more detailed scientific studies should be focused.

9.2.8 Decision-making

Unlike the HSNO Act and processes set up under that Act to consider issues affecting Maori, there is no equivalent or alternative system under the Biosecurity Act to enable Maori to either advise decision-makers or be involved in decision-making in relation to unwanted organisms, even though the concerns may be the same under both Acts (eg organisms that should be prohibited and prevented from entering New Zealand).

It is important that decision-makers understand the cultural concepts behind the information that is given by Maori. This may require active participation by iwi representatives at the decision-making level, and increased awareness among decision-makers about culturally significant issues.

9.2.9 Research

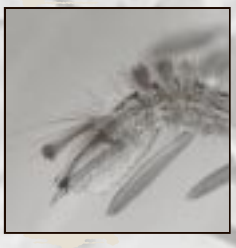
There is no evidence of any research having been done or planned to examine:

- biosecurity risks to Maori cultural values
- risks that imported organisms will adapt and become invasive or replace a native or valued introduced species of significance to Maori
- the impacts of ballast water and sewage discharges from ships on kaimoana.

It would benefit decision-makers to encourage and fund research to gain a better understanding of tangata whenua interests in indigenous and introduced flora and fauna, biodiversity and associated biosecurity issues.

9.2.10 Operational issues

The effectiveness, skills and resources among biosecurity agencies to assess and protect against harm to indigenous flora and fauna and other taonga need to be closely examined to ensure that they are adequate for the task. Individual agencies each have a responsibility to ensure that they have the staff, skills and funding to undertake their roles, including that of consulting with tangata whenua.



Public health interests in biosecurity are targeted at the prevention and control of imported diseases and disease vectors, and are dealt with primarily through the Health Act 1956 by the Ministry of Health and its agents. This section focuses on the potential impact on public health of the introduction into New Zealand and establishment of exotic mosquitoes.

10.1 Arboviral diseases

A number of reports have been written on the risk to public health of arboviral diseases (eg Ross River fever, dengue fever, Japanese encephalitis) occurring in New Zealand as a result of incursions and establishment of mosquitoes, which act as vectors for such diseases (Maguire, 1994; Weinstein *et al.*, 1997; Kay, 1997; Hearnden, 1999).

The issues raised in these reports included the following:

- Resurgence of arboviral diseases is a major public health problem worldwide.
- New Zealand has no record of any outbreak of mosquito-borne diseases, but arboviruses pose the greatest future threat.
- The risk of local transmission of arboviral diseases is compounding with time.
- Changing environmental conditions – such as global warming with associated effects on vector distribution, the increasing speed of air travel by viraemic[41] persons and the accidental introduction of new vector mosquitoes, particularly *Aedes albopictus*, could pose a threat in view of the fact that the human population of New Zealand is non-immune and would be susceptible to mosquito-borne diseases.
- At least four species of exotic mosquitoes that have the potential to transmit dengue and Ross River viruses (*Aedes albopictus*, *Aedes aegypti*, *Culex annulirostris* and *Aedes japonicus*) have been intercepted at New Zealand ports.
- Shipments of used tyres, machinery and vehicles from Japan are implicated as the pathway for the introduction of exotic mosquitoes into New Zealand. During 1995 almost 612,500 tyres were imported, mainly into Auckland (50.1%) and Lyttelton (37.3%).

[41] *Presence of virus in the blood.*

- Auckland presents the greatest risk in terms of mosquito entry and establishment (the greatest number of cargo entries at both the airport and port, highest annual temperature), numbers of potentially viraemic visitors, and potential damage to the non-immune population (largest population, second in population growth rate).
- *Aedes camptorhynchus* (southern saltmarsh mosquito), a vector for Ross River virus, is currently established in a limited region immediately north of Napier City, and, if uncontrolled, is likely to spread beyond its current distribution.[42] It will be an irreversible hazard to the Hawke's Bay region if populations are left unchecked. Should a Ross River virus epidemic occur, a conservative estimate of the economic cost to the region is likely to be in the order of $230,000 to $2.3 million per annum.

A 1997 report from the MoH to the Minister for Biosecurity (MoH, 1997) drew attention to the potential for mosquito-borne diseases to emerge as a significant public health issue. Among the key issues highlighted in this report were the following:

- The risk of an outbreak of arboviral disease in New Zealand is real and is likely to increase with time.
- The species of mosquito of greatest concern is *Aedes albopictus* (Asian tiger mosquito), a competent vector for Ross River and dengue viruses.
- Funding for exotic mosquito surveillance and border control[43] should be allocated on an at-risk basis as follows: 60% in Auckland and Northland, 20% in all other North Island ports and Christchurch, and 20 % elsewhere.
- Border control,[44] surveillance and ready reaction systems need to be able to respond effectively to the introduction of new species of exotic mosquito. Training of border control and other response staff in mosquito identification is an essential component of this surveillance.
- A national pest management strategy (NPMS) was considered as being the most appropriate option for the exclusion, eradication and management of exotic mosquitoes of public health significance.

42 *A press release from the MoH on 6 October 2000 announced the discovery of mosquitoes south of Gisborne, suspected to be the exotic southern saltmarsh mosquito. However, it was uncertain at that stage whether the mosquito had spread from Hawke's Bay or had arrived in Gisborne by some other means.*

43 *Funding for mosquito surveillance and control is from Vote: Health through the Health Funding Authority to public health services.*

44 *Border control activities related to health are undertaken by MAF and covered by a memorandum of understanding between the MoH and MAF. These activities are funded from MAF's border control baseline.*

Following consultation by the MoH on its discussion document *Towards a National Pest Management Strategy for Exotic Mosquitoes of Public Health Significance* (MoH, 1999), the Ministry identified a number of disadvantages in proceeding with the development of an NPMS. The MoH considered that there would be negative consequences from a formal strategy, and it could have the potential to remove resources from the public health services to the extent that the critical mass of most services could be threatened. The unique benefits of an NPMS (third-party funding and an ability to make rules) did not appear to apply to an NPMS for exotic mosquitoes of public health significance, and it was arguable whether the benefits of an NPMS would outweigh the disadvantages. The Ministry has discontinued work on the development of a NPMS for exotic mosquitoes and, instead, is working towards providing stronger leadership to the health sector on the surveillance, control, exclusion and management of exotic mosquitoes (MoH, 2000).

10.2 Other diseases

A serious risk mentioned by Green (2000, p 23) is pathogens arriving in ships' ballast water. The Australian Quarantine Inspection Service has a list of 148 pathogens that could arrive in ballast water, including cholera bacteria. In 1991 ships from south Asia are thought to have discharged ballast water containing cholera bacteria into Peruvian ports. The resulting epidemic killed thousands of people. Subsequently, ships outbound from South America have had cholera-causing bacteria detected in their ballast water in Australian and US ports.

11.1 Conclusion

Biosecurity is a risk management system operating without a clear set of measurable outcomes and it is administered by multiple agencies each with their own objectives. The system has traditionally focused on the management of risks to the primary production sector but, more recently, successive governments have recognised the importance of co-ordinating agencies' efforts to manage biosecurity risks to the environment and public health. The formation in 1997 of the Biosecurity Council as a Ministerial advisory body was the first significant step in this process. The Biosecurity Council and its consultative forums have an important role to play in co-ordinating all aspects of biosecurity and ensuring that the biosecurity system is effective. The establishment of MAF Biosecurity Authority in 1999 was another important milestone. It plays a pivotal role in implementing the Biosecurity Act 1993 and assessing biosecurity risks, including risks to New Zealand's biodiversity.

This report has examined the very broad range of issues associated with the management of biosecurity risks to the environment and has found that the system has a number of strengths but also significant weaknesses. The weaknesses identified are not insurmountable. There is an opportunity, in the development of the Government's proposed Biosecurity Strategy, to address the system's weak points and to set clear and measurable outcomes that the Government expects biosecurity agencies to work towards. Other measures such as improving public awareness of the importance of biosecurity to New Zealand, and encouraging the support and vigilance of communities and the private sector are also necessary.

11.2 Recommendations

The following recommendations are based on the findings of this report, and acknowledge the Government's commitment to *The New Zealand Biodiversity Strategy* (New Zealand Government, 2000a), which includes the development of a Biosecurity Strategy and the protection of marine biosecurity (section 8.5).

11.2.1 Recommendations to the Minister for Biosecurity

It is recommended that the Minister for Biosecurity:

a) Revises the representation on, and responsibilities of, the Biosecurity Council and its two forums (and the forums terms of reference) to encourage participation by tangata whenua, ensure a wider representation of stakeholders and expertise, and to provide the Minister with a regular assessment of the effectiveness of the biosecurity system (section 3.3).

b) Incorporates into the proposed Biosecurity Strategy:

   i. a statement that puts biosecurity into perspective, recognising that biosecurity, like national security, is essential for the protection of the country's key strategic asset – its natural resources (section 2.2);

   ii. the concept of shared responsibility for managing biosecurity risks, and public participation in monitoring and surveillance (section 2.5);

   iii. biosecurity risk management principles that will guide biosecurity decision-making (section 2.5.3);

   iv. criteria for assessing risks to indigenous flora and fauna, biodiversity, ecosystem health and public health and determining 'appropriate levels of protection against biosecurity risk' (section 3.5.4);

   v. adoption of the precautionary approach to managing biosecurity risks where information on the impacts on indigenous species is not available, limited or uncertain (section 3.5.5);

   vi. a statement that, to be effective, biosecurity should focus on controlling high-risk pathways by which exotic organisms arrive in New Zealand (section 3.6);

   vii. frameworks and processes for prioritising biosecurity research (section 5.7);

   viii. a statement about the importance of information sharing among stakeholders to assist biosecurity decision-making (section 5.8);

   ix. guidance on the public and private sectors' contributions to biosecurity funding, consistent with exacerbator/beneficiary responsibilities (section 6.3).

c) Specifies the outcomes expected of the biosecurity system (including environmental management outcomes) against which the effectiveness of the system (including the relevant legislation) can be assessed (sections 3.1 and 3.4).

d) Reviews the effectiveness of the Biosecurity Act 1993 in relation to the outcomes being sought and, in particular, its lack of:

   i. an over-arching purpose statement and set of principles;

   ii. reference to the Treaty of Waitangi and associated obligations;

   iii. a general duty to avoid, remedy or mitigate adverse effects;

   iv. any requirement on any particular agency to take action (section 3.4).

e) Ensures that, in the distribution of Votes: Biosecurity resources are appropriately allocated and maintained to address biosecurity risks to indigenous flora and fauna, biodiversity, ecosystem health and public health (section 3.2).

f) Establishes dedicated funding arrangements and criteria to enable rapid and effective responses to biosecurity emergencies (section 3.7.1).

g) Increases New Zealand's resources and capabilities in marine biosecurity to deal effectively with the risks associated with marine invasive species (section 5.9.1).

11.2.2 Recommendations to biosecurity agencies and others

It is recommended that:

a) MAF Biosecurity Authority, in consultation with other biosecurity agencies, develops and implements a strategy to increase the level of public awareness of, and compliance with, biosecurity requirements (sections 2.4.3 and 2.4.4).

b) MAF Biosecurity Authority and the Department of Conservation enter into formal arrangements to build and maintain the capacity and skills needed to efficiently and effectively assess biosecurity risks to indigenous flora and fauna (sections 3.5 and 5.9).

c) The Environmental Risk Management Authority (ERMA), in consultation with the Department of Conservation and MAF Biosecurity Authority, develops a relatively straightforward process that will encourage importers of new plant species or seeds to have them assessed for their weediness, invasiveness and other potential biosecurity impacts (section 3.5.1).

d) All biosecurity agencies develop firm agreements with MAF Biosecurity Authority, through memoranda of understanding or similar means, on their respective roles in relation to biosecurity breaches and emergency situations, and develop criteria for determining responsibilities for follow-up action (section 3.7).

e) All biosecurity agencies that contract border inspection services from MAF Quarantine Service ensure that the Service has appropriately trained staff and that it meets performance standards set by each contracting department and which accord with the Government's biosecurity outcome expectations (section 5.2.2).

f) All biosecurity agencies and the Biosecurity Council contribute to the co-ordination and targeting of biosecurity monitoring and surveillance, and exchange of information (section 5.4).

g) The Department of Conservation and the Ministry of Fisheries review their essential biosecurity information needs and determine whether sufficient resources are being allocated to operational research to meet those needs (sections 5.5.2, 5.5.3 and 5.9.1).

h) The Biosecurity Council co-ordinate and distribute information on publicly funded biosecurity research projects among all the biosecurity agencies, and encourage the private sector to contribute information on privately funded research (section 5.6).

A.1 Biosecurity Act 1993

A.1.1 General

The Biosecurity Act was introduced as 'an Act to restate and reform the law relating to the exclusion, eradication, and effective management of pests and unwanted organisms'. It repealed and replaced:

- the Animals Act 1967
- the Agricultural Pests Destruction Act 1967
- the Poultry Act 1968
- the Noxious Plants Act 1978
- most of the Plants Act 1970
- most of the Apiaries Act 1969.

In broad terms the Act deals with:

- the effective management of risks associated with the importation of 'risk goods'
- the effective management or eradication of 'pests'[45] and 'unwanted organisms'.[46]

The Biosecurity Act is an empowering Act rather than a requiring one. There is no requirement on any particular agency to take action in relation to the presence of a harmful organism.

The Act provides for an integrated system of biosecurity risk management comprising:

- import controls (by way of import health standards)
- border controls (eg inspection, detection, interception, clearance of goods)
- monitoring and surveillance (eg New Zealand's status in regard to pests and unwanted organisms)
- pest management strategies (to control or eradicate pests or groups of pests)
- emergency response (eg to an outbreak, occurrence, establishment or spread of unwanted organisms).

[45] *See definitions in s 2, Biosecurity Act 1993.*

[46] *An 'unwanted organism' will have that status throughout New Zealand (an organism cannot be an unwanted organism only within a particular region or other locality). Information on unwanted organisms can be found at: http://www1.maf.govt.nz/uor/searchframe.htm.*

A.1.2 Import controls

Under Part III of the Act, the Director-General of Agriculture and Forestry, on the recommendation of a chief technical officer (CTO),[47] may issue import health standards under the Biosecurity Act 1993 specifying requirements to be met for the effective management of the risks associated with risk goods before those goods may be imported, moved from a biosecurity control area or transitional facility, or given a biosecurity clearance. The Director-General need not issue an import health standard for risk goods if he or she considers that any requirements that could be imposed on such goods would not be sufficient to enable the risks to be managed effectively if the goods were imported.

MAF maintains a register of all import health standards issued.[48]

Inspection of goods may occur in the country of origin, but on arrival in New Zealand they must be accompanied by documentation certifying that they comply with the relevant import health standard(s) before they receive clearance.

A.1.3 Border controls

At the border (international airports, ports and mail centre), inspectors appointed under the Biosecurity Act 1993 assess risk goods for constituting or harbouring unwanted organisms and may give a biosecurity clearance authorising the importation of the goods if the goods comply with the relevant import health standard and –

- the documentation for the goods is in order; and
- the goods display no symptoms that may be a consequence of harbouring unwanted organisms; and
- the goods display no signs of harbouring organisms that may be unwanted organisms; and
- there has been no recent change in circumstances, or in the state of knowledge, that makes it unwise to issue a clearance.

When biosecurity clearance is given, goods are released into New Zealand unconditionally.

[47] *CTOs are appointed by the chief executives in each of the four government departments with biosecurity responsibilities (MAF, MFish, DoC and the MoH).*

[48] *See MAF's web site: http://www.maf.govt.nz/MAFnet/index.htm.*

A.1.4 Monitoring and surveillance

Part IV of the Biosecurity Act provides for the continuous monitoring of New Zealand's status in regard to pests and unwanted organisms:

- to facilitate the provision of assurances and certificates in relation to exports of organisms
- as a basis for the proper administration of the Act, including the institution of precautionary actions, emergency and exigency arrangements, and pest management strategies
- to monitor the effect of pest management strategies
- otherwise to enable any of New Zealand's international reporting obligations and trading requirements to be met.

Information collected may be used to communicate the animal or plant health status of New Zealand, or the occurrence of pests or unwanted organisms.

A.1.5 Pest management strategies

Pest management strategies are the principal mechanism, under Part V of the Biosecurity Act, for the effective management or eradication of pests and unwanted organisms that become established in New Zealand. Pest management strategies provide a commitment as to how an organism is to be managed or eradicated, who is responsible for the various activities, and the funding and compensation arrangements. The Act provides for the development and operation of these strategies without the need for the Government to be the initiator, provider or sole funder. There are two types: national and regional.

A Minister or any person may propose a national pest management strategy (NPMS). A Minister will notify an NPMS only if the Minister is satisfied that the proposal meets the prerequisites outlined in s 57 of the Biosecurity Act. A Minister may actively encourage or facilitate the development of an NPMS initiated by the private sector to manage or eradicate an organism that affects that Minister's responsibilities.[49]

[49] *Two NPMSs have been initiated by the private sector. The Animal Health Board Inc initiated the national bovine tuberculosis pest management strategy, and the National Beekeepers' Association initiated the national American foulbrood pest management strategy. These initiating agencies also became the management agencies for their respectiuve strategies. The Ministry of Fisheries may develop an NPMS to deal with Undaria seaweed – this would be the first NPMS for a marine species and the first NPMS for the Ministry of Fisheries.*

A regional pest management strategy (RPMS) can be prepared by a regional council or any person or organisation, but it has to be approved by the regional council in whose region the RPMS applies. A proposed RPMS undergoes a public consultation and submission process, including a right of appeal to the Environment Court. All pest management strategies (national and regional) must be reviewed every five years. Many regional councils are currently carrying out the first review of their RPMSs.

A regional council may, without a pest management strategy, undertake small-scale management of unwanted organisms subject to certain criteria (see s 100 of the Biosecurity Act).

A.1.6 Emergency response

Part VII of the Act provides for the effective prevention, management, or eradication of unwanted organisms if emergencies or other exigencies occur. The Governor-General may declare a biosecurity emergency on the recommendation of a Minister if there is an incursion into New Zealand of an organism (which is not established) that has the potential to cause significant economic or environmental loss, or both, if it becomes established in New Zealand. An emergency may also be declared in respect of an organism established in part of New Zealand to prevent it establishing in other parts; or an established organism that is becoming or has become so abundant or distributed that it has the potential to cause harm; or a pest that cannot be controlled by a pest management strategy. In every case, it must also be in the public interest that immediate action is taken to manage or eradicate the organism and that ordinary powers are not sufficient.

In a biosecurity emergency, the Minister may take such measures as the Minister believes on reasonable grounds to be necessary or desirable. An emergency ceases after four months unless the House of Representatives extends it. The Biosecurity Act also enables the Minister, under section 7A, to exempt actions to eradicate an organism, under Part VI of the Act, from the provisions of Part III of the Resource Management Act for up to 20 working days, subject to specified criteria.

A.1.7 Compensation

Section 162A provides for compensation to be paid to a person who suffers verifiable loss as a result of the exercise of powers under the Biosecurity Act for the purpose of the management or eradication of any organism, subject to some constraints. Compensation is not payable for any loss resulting from the exercise of powers in relation to the implementation of a pest management strategy (s 162A(6)). However, both national and regional pest management strategies must specify 'the basis, if any, on which compensation is to be paid by the management agency in respect of losses incurred as a direct result of the strategy' (sections 60A(h) and 80A(h)).

A.2 Hazardous Substances and New Organisms Act 1996

This Act was introduced 'to restate and reform the law relating to the management of hazardous substances and new organisms'. It repealed and replaced a number of Acts, including parts of the Animals Act 1967 and the Plants Act 1970.

The HSNO Act is concerned, among other things, with the assessment of applications to import for release, or release from containment, any 'new organism'.[50]

Under the HSNO Act, ERMA is responsible for granting or refusing approval for the importation and release, importation into containment, release from containment, field-testing, or development of new organisms (including genetically modified organisms).

In exercising its functions under the Act, ERMA is required to recognise and provide for or take into account specified environmental, human health, economic, and social and cultural factors. The environmental factors specified are:

- the safeguarding of the life-supporting capacity of air, water, soil and ecosystems (s 5(a));
- the sustainability of all native and valued introduced flora and fauna (s 6(a));
- the intrinsic values of ecosystems (s 6(b)); and
- the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, wähi tapu, valued flora and fauna, and other taonga (s 6(d)).

[50] *See definition in s 2, HSNO Act 1996.*

In addition, ERMA must take account of New Zealand's international obligations (s 6(f)) and the principles of the Treaty of Waitangi (s 8). It must take account of the need for caution in managing adverse effects where there is scientific and technical uncertainty about those effects – a formulation of the precautionary principle, which has become a feature of international environmental law (s 7).

The methodology ERMA is to apply to every decision is set out in the Hazardous Substances and New Organisms (Methodology) Order 1998 (1998/217) ('the Methodology Order'). The regulations address uncertainty and the precautionary approach, and the approach to be taken to risk. Clause 33 of the Schedule requires ERMA to take account of the extent to which the following risk characteristics exist:

- exposure to the risk is involuntary
- the risk will persist over time
- the risk is subject to uncontrollable spread and is likely to extend its effects beyond the immediate location of incidence
- the potential adverse effects are irreversible
- the risk is not known or understood by the general public.

Other departments with biosecurity information or expertise are notified if ERMA considers that they are likely to have an interest in particular applications. If the application is for the approval of a new organism, ERMA is required to notify DoC and any regional council that is likely to have an interest. ERMA must consult all the departments or Crown entities notified of an application under s 53(4), and, where the application is for approval to import, develop, field test, or release a new organism, have particular regard to any submissions made by DoC (s 58(1)(c)).

A.3 Health Act 1956

This Act is administered by the MoH and sets out provisions relating to the improvement, promotion and protection of public health. Matters relevant to biosecurity include:

- Part II – the powers and duties of local authorities, including requirements on local authorities to promote and conserve the public health and to secure the abatement of nuisances
- Part III – eg duty of ships' masters to notify suspected infectious diseases (s 76)
- Part IV – provisions relating to quarantinable diseases
- Part VI – regulations relating to public health, including prevention of the spread of infectious diseases.

Other biosecurity responsibilities of the MoH largely derive from the Biosecurity Act. The chief executive of the MoH may appoint CTOs for the purposes of the Act, who may exercise most[51] of the powers of CTOs appointed by the Director-General of Agriculture and Forestry (s 101 of the Biosecurity Act).

[51] *For example, CTOs of departments other than MAF cannot exercise powers relating to border control and clearance (including transitional and containment facilities).*

A.4 Forests Act 1949

Section 69 of the Forests Act, which is administered by MAF, prohibits the importation into, and the export from, New Zealand of any tree, seed, timber or timber product which may introduce any organism that may be injurious to any tree. Regulations may be made for the purpose of eradicating or preventing the spread of disease, which may affect trees (s 70). The owners of trees, forest products or buildings destroyed for the purpose of eradicating or preventing the spread of any disease may be paid compensation (s 70A).

Powers of entry must be exercised subject to certain restrictions unless there is immediate danger to life or property, and immediate entry is necessary to contain the outbreak, eradicate the disease or prevent its spread in order to avert serious damage to or destruction of any forest (s 71B).

The Forest Disease Control Regulations 1967/127 specify certain insects and diseases as forest diseases and prescribe measures to be taken to deal with outbreaks of such diseases. Areas where the diseases are identified may be declared to be infected areas and the owners or occupiers of those areas may be required to destroy or treat affected material. The removal of forest produce may be restricted. The regulations also provide for the setting up of an advisory committee to advise the Minister of Agriculture and Forestry in relation to the eradication or spread of forest diseases.

While there may appear to be a conflict or an overlap between the regulations made under the Forests Act and the Biosecurity Act, s 7 of the Biosecurity Act makes it clear that the exercise of powers under Part VII of the Biosecurity Act (emergency powers) is not to be affected by Acts including the Forests Act.[52]

[52] *At the time of writing, a Forests Amendment Bill is in the House. Among other things this Bill, if passed, will repeal the biosecurity provisions of the Forests Act 1949.*

A.5 Wild Animal Control Act 1977

The Wild Animal Control Act 1977 was enacted:

- to control harmful species of introduced wild animals; and
- to regulate the operations of recreational and commercial hunters so as to achieve concerted action and effective wild animal control.

There seem to be some contradictory objectives in this Act: on the one hand, harmful exotic species of animal should be eradicated where necessary and practicable; and on the other, concessionaires and hunters will not want certain species to be eradicated because either their livelihood depends on a steady supply of them or it is their favoured form of recreation.

A.6 Resource Management Act 1991 (RMA)

The purpose of the RMA is to promote the sustainable management of natural and physical resources (s 5); it includes an obligation on all persons to avoid, remedy or mitigate the adverse effects of their activities on the environment. While the RMA does not specifically provide for biosecurity matters, it is relevant to biosecurity in that a biosecurity system is intended to protect biodiversity (along with human health and international trade), which is an aspect of the environment covered by the RMA (MfE, 2000).

In specified circumstances, actions taken under the Biosecurity Act to eradicate an organism may be exempted from the provisions of Part III of the RMA for up to 20 days to enable action to be taken quickly (s 7A Biosecurity Act).

Included in matters of national importance, which the RMA requires to be recognised and provided for, is the protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna (s 6(c)).

A.7 Inter-relationships between the various Acts

The Biosecurity Act has been described as managing 'unwanted' organisms and the HSNO Act as managing 'wanted' organisms (MoRST, 1998).

A significant distinguishing feature is that the Biosecurity Act sets up a process for ongoing management of unwanted organisms (national and regional pest management strategies), and monitoring New Zealand's status in regard to pests and unwanted organisms (Part IV). In contrast, the HSNO Act makes no provision for managing or monitoring the effects of a new organism once approved for release from containment. A new organism approved by ERMA could, if it was capable or potentially capable of causing unwanted harm to any natural resources, be declared an 'unwanted organism' under the Biosecurity Act.

The Biosecurity Act appears to take priority over the HSNO Act (s 142(1) HSNO Act) where the exercise of emergency powers is involved. Apart from certain exceptions, the Biosecurity Act does not affect the provisions of the Acts referred to in s 7 (including the Forests Act 1949, the Conservation Act 1987, and the RMA). Exceptions to this include:

- the performance or exercise of any power, function or duty conferred by Part VII (exigency provisions) of the Biosecurity Act (s 7(1))
- in specified circumstances, actions taken under the Biosecurity Act to eradicate an organism may be exempted from the provisions of the RMA for up to 20 days to enable action to be taken quickly (s 7A)
- where powers under the Biosecurity Act are exercised on any land (except conservation estate) in respect of a pest or unwanted organism that may be transmitted by any animal to which the Wild Animal Control Act 1977 applies, the provisions of the Wild Animal Control Act do not apply (s 7(5))
- the extent to which the Acts are expressly amended by s 168(1) of the Biosecurity Act (s 7(2)(b)).

A.7.1 Prohibited and unwanted organisms

Both ERMA and the Director-General of Agriculture and Forestry have responsibilities relating to the importation of organisms into New Zealand under the HSNO Act and Biosecurity Act respectively.

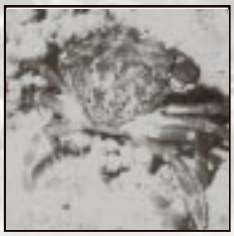
The HSNO Act contains a list of 'prohibited organisms' in its Second Schedule. These will not receive approval to be imported, developed, field tested or released. Under the Biosecurity Act, 'unwanted organisms' include those that a CTO believes are capable or potentially capable of causing unwanted harm to any natural resources or human health, and include prohibited organisms under the HSNO Act and any new organism the import of which ERMA has declined to approve.

A.7.2 Involvement of Maori in biosecurity decision-making

Section 6(d) of the HSNO Act requires decision-makers to take into account, *inter alia*, 'the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, wähi tapu, valued flora and fauna, and other taonga.

Clause 6 of the Schedule to the Methodology Order authorises ERMA to appoint an advisory committee in accordance with clause 42 of the First Schedule to the HSNO Act to advise it on any matter relating to its responsibilities under Part V of the Act. ERMA has appointed a committee known as Nga Kaihautu Tikanga Taiao to advise it on issues that may arise in taking into account the matters in ss 6(d) and 8 of the Act.

Section 57 of the Biosecurity Act sets out the prerequisites for a proposal for a national pest management strategy. One of the prerequisites is that the Minister proposing the NPMS is of the opinion that the organism to which the strategy relates is capable of causing serious adverse and unintended effects on one or more of a number of matters. One of those matters is the relationship of Maori and their culture and traditions with their ancestral lands, waters, sites, wähi tapu, and taonga (s 57(1)(c)(v)). Similar requirements apply to proposals for regional pest management strategies (s 72(1)(c)(v)). Regional councils, when preparing an RPMS, are required to consult the tangata whenua of the area who may be affected, through iwi authorities and tribal runanga (s 73(1)(c)).



The aim of this review of New Zealand's biosecurity system was to determine, from an environmental management perspective, whether the systems and processes in place are adequate to meet New Zealand's biosecurity needs. The case studies presented below attempt to illustrate relevant issues relating to the current systems and processes. In addition to specific incursions, there is a brief discussion about the national surveillance pest plants initiative and 'unwanted organism' status, and the impending threat of the northern Pacific seastar.

B.1 Painted apple moth

B.1.1 Background

On May 5 1999 an unusual caterpillar was discovered by a member of the public in an industrial area in the west Auckland suburb of Glendene. It was identified by MAF as the larva of the painted apple moth (*Teia anartoides*), a native of Australia, with the potential to establish over much of New Zealand. A second infestation of the painted apple moth was found, again by a member of the public, in the Auckland suburb of Mt Wellington on 28 September 1999, 15 kilometres from Glendene. The two incursions are thought to be unrelated.

Belonging to the same family as the white spotted tussock moth and the gypsy moth, the voracious moth is known to feed on a wide range of host plants, including acacia, radiata pine and pip and stone fruit trees such as apples, pears and cherries. The distinctive larvae – large, fat and profusely hairy – were found feeding on a number of exotic and indigenous plant species, including kowhai (to near defoliation) and ribbonwood. All life stages of the moth were found, leading to MAF's conclusion that that it had been present in New Zealand for at least one year.

The moth is suspected of arriving in New Zealand from Australia on shipping containers, and although natural dispersal ability of the moth is poor (the female is flightless), it can pupate and lay its eggs on inanimate objects, and humans can inadvertently disperse the moth over considerable distances. MAF acknowledge that the painted apple moth 'has the potential to seriously impact on New Zealand's forestry, conservation and horticulture' and that the threat posed is greater than that posed by the white spotted tussock moth, whose successful eradication campaign, co-ordinated by the former Ministry of Forestry three years before, had cost about $12 million.

B.1.2 Response to incursion

For both painted apple moth incursions, MAF immediately began a delimiting survey to within a 1-kilometre radius of each original infestation zone, dividing the area into about 1,300 sites to determine the extent of infestation. Localised ground spraying was carried out on host trees, building surfaces and shipping containers on infested properties with two insecticides: chlorpyrifos and deltamethrin. In addition to this, any egg masses, pupae and flightless female moths found were destroyed, and vegetation, including some host trees, was removed from some of the infested properties. Weekly checks of known infested sites were undertaken to monitor the effectiveness of treatments at both locations, and full-scale surveys were carried out every six to eight weeks. Auckland and Waitakere City Councils, Vigil Forest Health Advisory Services[53] and AgriQuality New Zealand worked with MAF in the field to contribute to the eradication programme.

Other actions included issuing a number of restricted place notices under the Biosecurity Act and imposing a ban on the removal of vegetation and other risk items from these sites, and providing residents in the area with a free garden rubbish removal service. MAF also requested assistance from members of the public to report any suspicious findings.

Research by HortResearch scientists began in August 1999 in an attempt to identify the painted apple moth pheromone that would ultimately act as an attractant to female moths, a strategy that proved vital in eradicating the white spotted tussock moth.

[53] *Vigil Forest Health Advisory Services were also involved with the white spotted tussock moth eradication response.*

B.1.3 Costs of the incursion

Up until July 2000 the cost of the eradication effort was met by MAF through a reprioritisation of funds originally intended for the commissioning of a new quarantine facility. A Cabinet paper was submitted in August 2000 to seek new Votes: Biosecurity funding for a two-year programme for the moth's continued eradication, with MAF anticipating that eradication of the moth would be completed by mid 2001.

MAF carried out a simplified cost–benefit analysis (CBA) in July 2000, following the framework used by the New Zealand Forest Research Institute's CBA for the white spotted tussock moth in 1997. It identified potential negative impacts on private and public amenity, plantation forestry, horticulture, the conservation estate, watershed conservation, human health and New Zealand's trade prospects, in the event of the painted apple moth's spread throughout New Zealand. The assessment conservatively estimated the cost of the impact, based only on private and public amenity and plantation forestry, to be $47.6 million over the next 20 years, and the outcome of the CBA was that 'these potential costs represent the benefits of successful eradication'. The impact on the conservation estate was uncertain.

Specific concerns to the conservation estate described in the assessment included damage caused by moth infestation to host species within indigenous forests and shrubland; secondary impacts on other organisms in the ecosystem, such as increased competition for resources; and a decrease in public amenity value and the considerable expenditure in attempting to limit or reverse damage to New Zealand's conservation estate. In addition to this, New Zealand's indigenous forests are already under great stress from introduced organisms and the painted apple moth's natural range of enemies is absent.

The CBA stated that 'where the impact on indigenous species is uncertain, a precautionary approach may be favoured'. It could therefore be assumed, that in addition to identifying the threat to the economy, identifying the threat to indigenous flora and fauna would also be a priority, and if taking a precautionary approach, the risk, and hence the costs, should be considered high until proven otherwise, especially in light of the painted apple moth's preference for kowhai.

B.1.4 Plant species vulnerability

The successful white spotted tussock moth eradication campaign undertaken by the former Ministry of Forestry included, as part of its risk evaluation, host feeding trials on indigenous and exotic plant species to identify the threat to New Zealand's conservation estate, and forestry and horticulture industries. Up until September 2000 painted apple moth host feeding trials on indigenous plants had not been carried out: MAF, on the advice of the technical advisory group (see below), considered that the provision of larvae from the small HortResearch breeding colony should be prioritised for pheromone development, caged trapping programmes and feeding trials on exotic herbaceous plants.

Problems with disease in the painted apple moth breeding colony in Auckland have led to HortResearch establishing a second breeding colony at their quarantine facility in Lincoln. With the anticipated build up of moth numbers in the second breeding colony, MAF is planning to carry out host testing on a number of herbaceous plants found within the incursion area, in order to ascertain the need for insecticide application to these plants during tree removal operations (due to the danger of larvae being dislodged from the tree during removal and surviving on herbaceous vegetation). MAF also plans to undertake a caged-moth trap system, using trapped female painted apple moths to attract any male moths in the area.

The decision not to undertake host feeding trials on indigenous plant species concerned DoC and MoRST, but despite their recommendation to Cabinet that provision be made from Votes: Biosecurity funds for host feeding trials to be included in the operational plan, this was not allowed for in Cabinet's approval of extra funding in August 1999. MAF stated that there was no need for host testing on indigenous species to be undertaken at that stage in order to identify what is at risk, as it had already been established that there was a risk to indigenous flora.

To add to concern, it was noted that the white spotted tussock moth increased its range of both host plant species and families with time, thereby increasing the potential risk to indigenous flora and fauna. In light of similarities between the two species, this behaviour could also be expected of the painted apple moth, further justifying the urgency for host feeding trials on indigenous flora.

B.1.5 Lessons learned

Concern has been expressed at MAF's failure to identify and consult all individuals with relevant technical expertise and experience (at the earliest opportunity), despite direct offers from some involved in the recent successful eradication campaign for the white spotted tussock moth.

A technical group was convened by MAF in mid-1999 to provide advice and peer review on the painted apple moth response. DoC was not invited to attend these meetings until over a year into the incursion response, another serious oversight in stakeholder representation, considering that the threat to the conservation estate from the painted apple moth is very real. Although sole agencies may have successfully dealt with eradication in the past, it is in the interest of the well-being of our economy, environment and society for all stakeholders to be identified and included in consultation as early as possible. Neither can any agency afford to assume that another agency is taking care of the matter satisfactorily, if they in any way have a stake in the outcome and are not being included in consultation.

Some stakeholders have raised concerns about MAF's lack of communication with them, and reluctance to provide information throughout the response to them. There has also been criticism of MAF's lack of regard for advice offered through consultative processes with the technical group, and lack of sharing of relevant and up-to-date information with regards to the eradication campaign.

Other criticisms were directed at aspects of the eradication campaign, including the appropriateness of quarantine measures, delimiting survey design, insecticide choice, spraying procedures and timing of pheromone development. MAF intend to commission an independent review of the painted apple moth eradication initiative in 2001.

B.1.6 Conclusions

The painted apple moth incursion serves to illustrate a number of biosecurity-related issues:

- lack of contingency funding for the eradication response
- poor risk analysis for indigenous flora and fauna
- poor consultation processes between central government agencies, and between MAF and the technical group
- a failure to identify and consult with all stakeholders (in particular those with relevant experience)
- the importance of the public's role in discovering incursions
- poor communication processes between MAF and some stakeholders.

B.2 Eastern banjo frog

B.2.1 Background

In October 1999 some unusual tadpoles were reported to the MAF's National Centre for Disease Identification (NCDI). The initial report was of the discovery in a stream in the Waitakere Ranges in August 1999 by a member of the public, but subsequent investigation strongly suggests that the frogs were 'planted' in this location. The tadpoles were identified as the eastern banjo frog (*Limnodynastes dumerilii*) from Australia.

This frog preys aggressively on a wide range of invertebrates and can also consume small vertebrates. Concerns were held for our indigenous skinks and frogs, in particular Hochstetter's frog, found in the Waitakere Ranges. The eastern banjo frog is also known to carry the chytrid fungus, implicated in amphibian declines in Australia.

B.2.2 Response to incursion

MAF contracted herpetologist Tony Whitaker to consult on the issue, and a preliminary survey was carried out in early November, finding tadpoles and metamorphlings at the reported site of incursion in the Waitakere Ranges. Several thousand tadpoles were also found in aquaria at the home of the original informant.

NCDI identified and called a meeting of stakeholders: MAF, because of the biosecurity breach, DoC, because of the threat to indigenous biota, and the Auckland Regional Council (ARC), as predominant landowner of the Waitakere Ranges. Staff from MAF, DoC and the ARC undertook a delimiting survey of the entire Waitakere Ranges from 8 to 11 November. This involved daylight searches for egg masses, tadpoles and frogs and night-time searches for frogs, listening for their distinctive call and playing recordings of their call for response. No further populations were found.

An Australian expert was brought to Auckland at this time to consult on the ecology and reproductive cycles of the species, and to investigate habitat suitability for the species' establishment. It was concluded that the site at which the frogs were reportedly found was most unlikely to have been a suitable habitat for breeding and development of the species. However, there was a high risk of the species breeding and proliferating in a range of habitats in New Zealand, including parts of the Waitakere Ranges and catchment areas.

A Biosecurity Technical Forum meeting was held in mid-November, at which the inter-agency programme to complete a detailed site survey and to seek public assistance in reporting signs of the frog was endorsed.

Subspecies identification was carried out in Australia: the frog found in New Zealand was identified as *L. dumerilii grayi* from coastal New South Wales. Each of the five subspecies has a different ecology and life history, with implications for the investigation, risk assessment and control of the incursion.

The MAF Enforcement Unit began an investigation to determine how and when the incursion occurred. They strongly suspected, for a number of reasons, that the species was recently and deliberately introduced at the site in the Waitakere Ranges. A detailed survey carried out a week later at the original site in the Waitakere Ranges found no evidence of the eastern banjo frog, probably because the site is an unsuitable habitat for this species, and any remaining tadpoles from the presumed release were likely to have been washed away in recent heavy flooding throughout the area. Eggs allegedly collected from the site had been hatched in uncovered aquaria in Auckland and distributed to other aquaculturists in the city, leaving a small risk of metamorphlings escaping into the wild. All known captive populations were destroyed.

MAF, in conjunction with the ARC, will monitor potential breeding sites in the Waitakere Ranges for at least two years (beginning August 2000). Remote decoy tapes will be placed at the original site and in adjacent catchments during the spring and autumn breeding seasons. ARC field staff will carry out night-time listening surveys during optimum breeding times and conditions, and will search for egg masses at optimum times from March to May and August to November.

In June 2000 DoC declared all species of the *Limnodynastes* genus 'unwanted organisms' under the Biosecurity Act 1993. The agency hopes to encourage the public to report any occurrences of unusual frog calls in the region as part of a publicity campaign, in which a fact sheet is to be developed and distributed before the end of 2000.

B.2.3 Future responsibilities

The arrival of the eastern banjo frog in New Zealand had not been predicted, and there was no specific emergency management plan prepared: it has been a case of applying generic MAF emergency response principles and procedures developed for handling incursions of other pests and diseases, and learning by doing with regards to the particular species. Several reports have been produced documenting the actions taken throughout the banjo frog response campaign, and recording this type of information should serve to improve the agencies' operational capability and technique when another similar incursion occurs.

When a similar incursion occurs elsewhere, the same initial response model will be followed with MAF taking the lead. It is recognised that NCDI has the response capability that can be applied generically in consultation with experts and stakeholders.

MAF sought and gained new initiative funding in the July 2000 budget to appoint an Exotic Animals Programme Coordinator to develop standards and a memorandum of understanding between agencies. In the absence of operating standards and memoranda of understanding between agencies the risk of an ineffective incursion response increases.

Although MAF will lead the response during the two-year monitoring period, if the eastern banjo frog is proven established in the Waitakere Ranges, the lead central government agency role will transfer to DoC, who would then have primary responsibility for ongoing management (eradication, control or acceptance).

B.2.4 Conclusions

The initial response to the eastern banjo frog has, to date, been well co-ordinated: stakeholders were identified and involved at an early stage and co-ordination, consultation and overall communication between the three agencies has been described as good. The response has also utilised the combined resources of central and local government agencies, including the use of on-the-ground staff for monitoring.

B.3 Argentine ant

B.3.1 Background

The Argentine ant, *Linepithema humile*, native to Argentina and Brazil, was first discovered in New Zealand in 1990 at the site of the Auckland Commonwealth Games. The ant has long been a pest in the US, Australia and South Africa, with deleterious effects across environmental, economic and social spheres.

The ability of the Argentine ant to prey upon, out-compete and displace native invertebrate species is well documented. In parts of South Africa the mutualistic relationship between native ants and some species of Protea has collapsed. The plants rely on the native ants for seed dispersal and burial, but the native ants have been displaced, leaving the seeds exposed to the dangers of rodent predation and fire, with eventual consequences for plant community structure. In some areas of California the coastal horned lizard population has gone into decline since the Argentine ant arrived and displaced native ant species, which are an important part of the lizard's diet.

The Argentine ant is an agricultural pest in California. The ants protect the aphid and other sap-sucking pests from predators in order to feed on their 'honey dew' secretions. The resultant increase in aphid population density can have devastating effects on citrus fruit, tomato and avocado crops, especially for growers using integrated pest management (IPM), a system that utilises predatory insects to control pests. In South Africa, the ant invades beehives to steal honey, and they compete with honeybees for sources of nectar. The Argentine ant is also a major domestic pest, invading houses in dense trails, to swarm over food and enter refrigerators and even screw-top jars.

The extent of the threat that the Argentine ant poses to indigenous flora and fauna and primary industry in New Zealand is, at this stage unknown, but if its effect in other infested countries is any indication, the prognosis is grim.

B.3.2 The ant's spread

After undertaking an immediate survey of the infested area, the Ministry of Agriculture and Fisheries (as it was in 1990) made the decision not to attempt eradication of the ant because of the lack of effective monitoring tools available to ascertain its full distribution accurately and the lack of control tools available at the time. It was also not considered a threat to agriculture.

Since its discovery a decade ago, the Argentine ant has become well established across Auckland, significantly aided by human activity. The collection and disposal of rubbish from infested areas has contributed to its dispersal, as has the movement of goods located within infested areas, such as items purchased from plant nurseries and car dealers. As a consequence, the ant has since been discovered in Northland, Waikato, Bay of Plenty, Wellington, and Canterbury.

The largest of these known infestations is in the Bay of Plenty: 22 hectares in an industrial area around the port and 11 hectares two kilometres away. In other regions the areas of infestation are small, mostly confined to less than 2 hectares. Results from trials in Australia indicate that cost of ant eradication is AU$1220 per hectare compared to an ongoing annual cost of AU$800 per hectare for ant control.

There is a distinct lack of information about the threat the ant poses in a New Zealand context (eg the ant's impact on native flora and fauna) and so there is a pressing need for research. Landcare Research has recently secured funding from the Foundation of Research, Science and Technology and DoC to research the Argentine ant, and is undertaking a nationwide survey that will contribute vital knowledge for future eradication or control of the ant. Landcare Research has an experimental use permit to undertake trials of a bait recently developed in Australia specifically for the ant.

The ant has also been found on Tiritiri Matangi Island, a DoC reserve in the Hauraki Gulf. An attempt at eradication will be carried out this summer, in a joint effort by DoC, Landcare Research and commercial pest controllers, using the bait under trial.

Concerns have been raised about the possibility of international trade bans because of the risk of exporting infested goods from the Port of Tauranga to countries in Asia presently free of the Argentine ant. Environment Bay of Plenty undertook a delimiting survey of their ant infestations in 1998 and sought funding for eradication to no avail, and the ants remain. Another delimiting survey will be carried out this summer to determine the extent of the ant's spread during the past two years.

B.3.3 Legislation, policy and implementation

There has been confusion over central and local government authority responsibilities for eradication or control of the ant – there are management implications for MAF, DoC and MoH as well as affected regional councils around New Zealand. For action to be taken against the Argentine ant under the Biosecurity Act the ant must either be a 'pest' (the subject of a pest management strategy) or an 'unwanted organism'. An unwanted organism is defined in the Act as 'any organism that a chief technical officer believes is capable or potentially capable of causing unwanted harm to any natural and physical resources and human health'. So far there has been no move from any central government agency CTO or request from any regional council to declare the Argentine ant an unwanted organism (regional councils can submit a request to MAF's unwanted organisms co-ordinator, who then notifies the relevant CTO for decision), nor has anyone prepared a proposal for a pest management strategy.

If the Argentine ant was declared an unwanted organism, those regional councils with small infestations could then deal with the ant under section 100 of the Biosecurity Act by undertaking small-scale management. Small-scale management of an unwanted organism by a regional council is only possible if the organism could cause serious adverse effects unless early action to control it is taken; the organism can be eradicated or controlled effectively within three years of control commencement because distribution of the organism is limited and technical means to control the organism are available; and the cost of control is likely to be less than $100,000.

The alternative, at a regional level, would be to propose a RPMS for the ant, a time-consuming and costly process compared to small-scale management. The choice of management strategy depends on the nature of the incursion – in the case of the Argentine ant, some regional councils may feel that the most appropriate and practical strategy would be to deal with the ant on a small-scale management basis.

Following concerns from regional councils of timeliness in requesting unwanted organism status, the CTOs in the four biosecurity departments have recently committed the process to a 10-12 day time-frame and developed a form for regional council use titled *Request to Determine an Organism Unwanted for the Purposes of the Biosecurity Act 1993*. If the CTO declines the request from the regional council to declare the organism unwanted,[54] the regional council's only option is to propose a RPMS but, as mentioned above, this may not be the preferred option if the organism can satisfactorily be dealt with by small-scale management.

In their policy technical paper titled *Regional Implementation of the Biosecurity Act 1993*,[55] MAF states that regional councils may be limited in their ability to be proactive in respect of small-scale pest management, because notifying a RPMS or using Section 100 both require a reasonably significant effort. The paper advocates amending the Biosecurity Act to allow regional councils to declare unwanted organisms in their region and to allow retrospective notification of a Section 100 action in respect of a pest, or alternatively allow regional councils the power to undertake a small-scale management programme without the need to first declare the organisms unwanted. There is concern over the time it is taking to make these suggested amendments.

The regional approach to management of the ant raises issues of national consistency, hence central government agencies and local authorities need to work together to determine whether a regional or nationally co-ordinated approach is the best strategy for eradication or control of the ant. In the case of the latter, MAF, DoC, MoH or a stakeholder industry group could propose a NPMS.

While it appears that genuine concerns are held for the ant's spread, there have been reports of central and local government authorities being unwilling to take responsibility for eradication or control of the Argentine ant. The first step would involve declaring the ant an unwanted organism, and although authorities are under no obligation to act once unwanted organism status has been granted, no authority has moved to do this. It is possible that this unwillingness may stem from a fear that, in the long term, eradication of the ant may be impossible, and therefore, no one authority wants to take initial responsibility because they may end up inheriting ongoing responsibilities and costs associated with long-term control.

[54] *A recent request from a regional council to declare the cattle tick Haemaphysalis longicornis an unwanted organism was declined on the basis that cattle and deer host the tick, therefore under sections 52 and 53 of the Biosecurity Act it would be an offence to move or sell a host animal, thus creating an unacceptable situation in areas where the tick is widespread.*

[55] *http://www.maf.govt.nz/MAFnet/publications/regbio/regimpbi-16.htm.*

B.3.4 The situation in Auckland

While small-scale management of the Argentine ant is suited to some regions, the requisites for this strategy under the Biosecurity Act are not met in the Auckland region because of the ant's extensive spread. The only option left to the Auckland Regional Council for control or eradication of the ant is to include the ant in their RPMS.

Doubts have been cast on the possibility of ever eradicating the ant from Auckland, but measures have been suggested to reduce the likelihood of further spread around the country. These include intensive baiting and monitoring programmes in key areas of infestation around the city and the establishment of an education programme to inform residents on practical matters that contribute to limiting both the ant's spread and the impact on their households and businesses. If the Auckland Regional Council chooses to take no action, it may be left to private individuals to carry out ant control on their own properties, with the far greater risk that the ant will spread throughout the country because of the lack of a co-ordinated response.

B.3.5 Information sharing

The Argentine ant incursion highlights the important role that members of the public and non-governmental organisations play in biosecurity matters: through the vigilance of a non-governmental organisation, a number of regional councils were informed of the ant's presence in their region.

This situation also highlights the need for improved information sharing between regional councils and other organisations (such as pest management companies or museums) that may be the first to confirm the presence of a new pest within a region.

B.3.6 Conclusions

If the Argentine ant were eradicated from regions where its distribution is contained, and controlled in Auckland where it is widespread, it would decrease the risk of spread into other regions. Delay in authority uptake of the problem only exacerbates the situation. Co-operation between central government agencies and local authorities in deciding the best strategy is essential.

It is hoped that in addition to those positive actions already being undertaken, such as DoC's planned eradication of the Argentine ant from Tiritiri Matangi Island and Landcare's nationwide surveying programme, moves will be taken to declare the ant an unwanted organism so that attempts to eradicate and control the ant can begin in a co-ordinated way.

B.4 National surveillance pest plants and 'unwanted organism' status

The 'national surveillance pest plants initiative' began around 1995, through consultation with MAF, the Nursery and Garden Industry Association, DoC, Crown Research Institute botanists and ecologists, the Royal Forest and Bird Society and regional councils, and led to the compilation of a list of 110 harmful plants. Regional councils were able to include some or all of those listed species as 'pests' within their RPMSs, making it an offence to sell, propagate, distribute and commercially display those 'pest' plants (s 52 and s 53 of the Biosecurity Act 1993). Additionally, councils were able to make specific rules in pest management strategies for those harmful plants that required tougher control measures.

A proposal, developed by MAF Biosecurity Authority and supported by the Pest Management Strategy Advisory Committee, is out for public consultation in an effort to best secure the future of the initiative. This is in response to concerns over inconsistencies among regional councils in their inclusion of harmful plants from the list as 'pests' within their RPMSs, and concerns that (through recent amendments and appeal provisions to the Biosecurity Act) more robust analysis may be necessary for each plant on the list. The proposal suggests reviewing the list and using 'unwanted organism' status under the Biosecurity Act for species of concern, so that regional councils can continue to enforce sections 52 and 53 of the Biosecurity Act as well as carry out small-scale management of them. This avoids the need for each council to include the listed species in their RPMS.

It is hoped that a formal multi-party accord will be drawn up and signed by the relevant government departments and regional councils in the near future, and that this integrated approach to dealing with the issues will provide a model for other national initiatives.

B.5 Australian snakes

MAF is taking measures after the discovery of two Australian venomous snakes within six months in an industrial area at Petone. On both occasions, shipping containers of used vehicle batteries imported from Australia were implicated as the likely pathway.

In March 2000 an eastern brown snake (*Pseudonaja textilis*) was discovered, and six months later an eastern small-eyed snake (*Rhinoplocephalus nigrescens*) was found. It is likely that the snakes, which were subsequently euthanased, would be able to survive in New Zealand conditions. It is thought that the snakes move into the battery-stacked pallets while they await loading into the shipping containers. MAF is working with the company importing the batteries to develop a safer method of loading the containers offshore in order to reduce the risk. In the meantime, MAF have established a mandatory fumigation programme for all shipping containers of used vehicle batteries.

These two incursions within a short time, and with a high likelihood of identical pathways, highlight the importance of pathway-focused biosecurity strategies, and of dealing with risks both pre- and post-border. Petone is currently the only pathway in New Zealand for shipping containers of used vehicle batteries.

B.6 Marine species in New Zealand

B.6.1 Background

The most common human-mediated mechanisms of dispersal for invasive marine species are by ships' ballast water and hull fouling. It is estimated that 4 - 6 million tonnes of ballast water are discharged into New Zealand waters from about 3,000 visiting ships per year. With growth in international shipping, and the increasing size and speed of bulk carriers on international shipping routes, the survival of exotic organisms in ballast water and on ships' hulls is even more likely.

The majority of marine invaders fail to establish, but some can create ecological havoc, competing with and displacing, or preying upon and exterminating, native species. Marine invaders can also harm cultural, recreational and commercial values of the marine environment.

Once established, invasive species may further disperse around New Zealand's coastline via local shipping, causing widespread devastation. A recent survey (Cranfield *et al.*, 1998) identified 148 marine species that are known to have been introduced to New Zealand.

B.6.2 Government agency responsibilities in the marine environment

While DoC has oversight responsibility for coastal management under the Resource Management Act, MFish assumed responsibility under the Biosecurity Act 1993 as lead agency for incursion response and surveillance in the marine environment in November 1998. Since then, MFish has developed a strategy for ballast water and ships' hull defouling, with the aim of managing the risk of introduction of exotic marine organisms by these vectors.

An Import Health Standard[56] For Ships' Ballast Water From All Countries was issued in 1998 under the Biosecurity Act, to provide mandatory control on the discharge of ballast water in New Zealand waters. The standard recognises that in some circumstances (eg severe weather conditions), mid-oceanic ballast water exchange may not be possible and an exemption may be granted. Exemptions are not granted to boats that have loaded ballast water in higher risk areas (eg Tasmania and Port Phillip Bay, Australia, because of the risk of invasion by the northern Pacific seastar), and discharge is not allowed under any circumstances.

[56] *An import health standard specifies the requirements to be met, in the country of origin or export, during transit, during importation and quarantine, and after introduction, for the effective management of risks associated with the importation of risk goods.*

In June 2000 the Minister of Fisheries announced a $40 million package for research and management of the marine environment over the next five years as part of Budget funding for the New Zealand Biodiversity Strategy. Of this, $9.8 million is to be allocated for marine biosecurity funding, and will include baseline surveys of New Zealand's nine busiest ports to increase knowledge of indigenous marine biota; risk assessment of invasive species; improving marine surveillance; ballast water monitoring; and the development of rapid response measures against invasive species arrivals.

B.6.3 *Undaria pinnatifida*

Background

Of the 19 species of algae identified in the survey of exotic marine species established in New Zealand, perhaps none has received more attention than *Undaria pinnatifida*, first discovered in Wellington harbour in 1987. The rapid-growing kelp is native to Japan, Korea and China, where it is a major cultivated edible crop. *Undaria* can occur in dense stands, shading biota underneath, occupying shores of varying exposure, with a wide vertical distribution from low tide level to up to 18 metres deep.

For centuries *Undaria* has been selectively cultured to grow on suspended artificial surfaces, lending itself to establishing on boat hulls and in ports and harbours. These tendencies contribute to its spread via coastal shipping, fishing and recreational boating activities to other New Zealand ports and harbours, and *Undaria* has subsequently been found in Napier, Gisborne, Porirua, throughout the Marlborough Sounds, Nelson, Golden Bay, Lyttelton, Akaroa, Timaru, Oamaru, Moeraki, Otago Harbour, Bluff and Stewart Island.

It is feared that an absence of competitors, in addition to the points above, will result in *Undaria* becoming widespread and displacing native algae around New Zealand's coastline, including the sub-Antarctic Islands, with devastating effects.

Undaria in Stewart Island

Undaria was first found at Stewart Island in March 1997, on mussel farms in Big Glory Bay, which lies within Paterson Inlet, a large sheltered harbour and site of national significance because of its pristine coastline and high level of biological diversity. DoC, concerned that the local biodiversity might be at risk, began an eradication programme the next month in conjunction with local marine farmers, with the aim of controlling its spread, and eventually eradicating it from Stewart Island. The programme, later extended to include Bluff Harbour, secured Votes: Biosecurity funds in August 1997 ($145,000) and July 1998 ($330,000).

If the shoreline of Stewart Island were permanently colonised by *Undaria*, the resultant reduction in light levels to coralline algae living below could give non-typical algae and benthic animals a competitive advantage, thus modifying community structure. Coralline algae produces important chemical cues for settlement by paua (*Haliotis*) larvae, and their absence could lead to a reduction in PAU5B[57] paua stocks. There could also be potential problems for mussel farmers: increased weight of ropes and buoys may sink longlines, mussel growth may be hindered, and machinery may be ill-equipped to process shells fouled by *Undaria*. There is also potential for *Undaria* to colonise shallow Bluff oyster beds.

Contracted divers remove pre-reproductive sporophytes from mussel lines and buoys and marine farmers have removed heavily infested rafts and buoys, and sterilised and applied antifouling compounds to structures. These efforts have been successful in reducing *Undaria* abundance by approximately 89% in managed areas, but the incidence of founding populations and the unknown longevity of the microscopic gametophyte stage contribute to uncertainty regarding the long-term outcome of the programme.

DoC also established a vessel-monitoring programme and database, to determine both the extent to which the coastal fleet is fouled by *Undaria* and the volume of vector traffic between ports. This programme alerted MFish to the danger of possible *Undaria* infestation of the Chatham Islands before the sinking of the vessel Seafresh 1 at Hanson Bay.

In May 1999 $2.1 million was allocated from Votes: Biosecurity funds for the *Undaria* eradication programme in Stewart Island over the next five years.

[57] *The Quota Management System controls the total commercial catch from all the main fish stocks found within New Zealand's 200 nautical mile EEZ. Within the commercial catch limit, access is determined by ownership of quota. Quota is a right to harvest a particular species in a defined area. QM5 covers the Otago/Southland area, and PAU5B is the quota code for paua stocks in the area around Stewart Island (5B).*

Undaria nationwide

Initially DoC took the lead in *Undaria* management in Stewart Island by default. Since then, MFish have become the lead agency for marine biosecurity and now have responsibility for *Undaria* management nationwide.

MFish, following direction by Cabinet to prepare a proposal for a NPMS for *Undaria* by 30 June 2000, let a contract for the development of management options for the seaweed in 1998. Since the declaration of *Undaria* as an 'unwanted organism' in March 2000 (after the Seafresh 1 incident in the Chatham Islands), MFish have had other national-level management options available for consideration.

The chief executive of MFish could now exercise powers under Part VI of the Biosecurity Act 1993 in relation to *Undaria* (as an 'unwanted organism'), without the need to develop a NPMS. The provisions under Part VI of the Biosecurity Act vary from those of a NPMS in a number of ways: under a NPMS a Minister is able to create strategy rules placing obligations or duties on people and secure financial contributions by way of a levy (whereas levy provisions under Part VI of the Act are imposed by the Governor-General on the recommendation of the Minister of Biosecurity). In addition to this, compensation provisions can be varied for loss or damage that occurs to private property as a result of the use of pest management provisions.

In light of the differences between these regimes, the Minister for Biosecurity has chosen to develop the framework for *Undaria* management as a NPMS proposal because of the ability to limit compensation provisions under that regime. Notification of the NPMS proposal, though, is dependent on its going through a prioritisation exercise.

The proposed NPMS, supported by MFish, DoC and MfE, focuses on protecting selected highly valued areas of coastline and developing a framework to empower local authorities to manage the seaweed in areas of importance to local communities. The proposal ensures, as much as possible, that those that benefit from any management actions will contribute to the costs.

Whether *Undaria* eradication and control will be managed under a NPMS or by powers exercised under Part VI of the Biosecurity Act remains to be seen at this stage. There are doubts that dealing with *Undaria* under Part VI of the Act would provide for national strategic management in the long term (as an NPMS would), and there are concerns that this approach would result in ad hoc *Undaria* management.

DoC stresses the importance of applying an exacerbator/ beneficiary model of cost sharing (by way of a levy) to *Undaria* management in order to spread the cost of eradication and control fairly across stakeholders (eg shipping companies, port authorities, marine farmers, tourism operators and regional councils), rather than it falling entirely on central government. Also, enforceable rules may be the most effective way to adequately control movement of *Undaria* vectors such as mussel spat and marine farming equipment.

DoC has raised concerns that valuable information gleaned in the consultative process of working towards the proposal for a NPMS may be lost if the proposal for a NPMS was not notified, as would further opportunity for public consultation and submissions. The importance of consultation with potentially affected parties and other government agencies with regard to understanding the issues surrounding *Undaria* management cannot be stressed enough, especially in light of experience gained by DoC in learning by example with their eradication and control efforts.

Concerns have been raised over MFish's lack of contingency planning and operational capacity with regard to *Undaria*, and thus their ability to cope in emergency situations, but the manner in which MFish managed the Seafresh 1 incident, in consulting with DoC and the Maritime Safety Authority, was encouraging. It is likely that MFish would contract DoC to assist with future control and eradication of *Undaria*, as DoC has people on the ground and extensive experience of these issues.

It has been suggested that MFish should undertake ongoing marine biosecurity surveillance at each of the nine main ports once the proposed baseline surveys have been completed, so as to continue monitoring the state of the marine environment and increase the likelihood of rapid detection of incursions in the marine environment.

B.6.4 The northern Pacific seastar

While not yet detected in New Zealand waters, the estimated costs to the fishing and aquaculture industries of the arrival of the northern Pacific seastar is $200 million per year in lost revenue and $10 million per year in control efforts (Mountford, 1998).

The northern Pacific seastar (*Asterias amurensis*) was discovered in southeast Tasmania's Derwent estuary in 1992. Native to coastal waters of Japan, North China, Korea and Russia, the seastar is a rapid breeder with a voracious appetite, preying on a wide range of marine organisms, including mussels and scallops. The seastar poses a threat to marine biodiversity, the aquaculture industry, and scallop and abalone fisheries in Tasmania. It is thought to have arrived in the late 1970s or early 1980s from Japan, as larvae in ballast water or as juvenile or adult seastars on ships' hulls. In a short time it has become the most dominant species in the local benthos, reaching extremely high densities – population estimates are approaching 30 million. It was discovered in Port Phillip Bay, Victoria, in 1995 where it has reached numbers thought to be in excess of 12 million. With a potential distribution from Perth to Sydney the seastar will likely have a massive ecological and economic impact on Australia's marine environment.

MFish launched a biosecurity surveillance network in 1999 in an effort to raise public and stakeholder awareness of the need for vigilance with regard to pests in the marine environment. The campaign appealed to the public to report sightings of six species (including the northern Pacific seastar) likely to be pests in the New Zealand marine environment if they were to invade. This one-off effort, with a budget of $35,000, involved setting up a free phone-line and producing a booklet, poster and web page. As mentioned previously, MFish has also imposed mandatory controls within the import health standard on the discharge of ballast water from Tasmania and Port Phillip Bay, in an attempt to reduce the risk of the northern Pacific seastar arriving in New Zealand.

Although MFish has developed a protocol to provide a framework for incursion response, it has not devised emergency contingency plans for any particular species, instead dealing with incursions under the Biosecurity Act as they arise. Concerns have been raised over this lack of specific emergency contingency planning, especially for species like the northern Pacific seastar that have a very high probability of turning up in New Zealand waters.

If permanent marine biosecurity surveillance positions were created at each of the nine main ports around New Zealand, the resulting monitoring and surveillance would increase the chances of early discovery of the northern Pacific seastar, enabling swift intervention, thus reducing the risk of its becoming established.

B.6.5 Conclusions

Despite efforts to deter the arrival of exotic marine organisms in New Zealand with more potent antifouling paints, speedier port turnarounds and mid-oceanic exchange of ballast water, it is estimated that as many organisms have arrived during the last 40 years as did in the 50 years prior, probably a reflection of increased global shipping and fishing activities.

The funding commitment by MFish as part of the New Zealand Biodiversity Strategy should lead to improvements in the area of marine biosecurity management over the next five years. Improving the taxonomic knowledge of New Zealand's marine flora and fauna and increasing monitoring and surveillance in the marine environment should make it more difficult for recent arrivals to go unnoticed, as not all exotic marine species are as obvious as *Undaria*. By taking a more proactive stance, and developing specific contingency plans for exotic marine species that are expected to arrive in New Zealand waters, the risk of those species becoming established is likely to be reduced. Strengthening operational capacity to deal with marine incursions should also reduce that risk.

It is hoped that an effective long-term, national-level strategic management plan for *Undaria* will be developed and implemented in the near future. The importance of consulting with stakeholders and agencies with relevant experience cannot be over-emphasised in deciding on a suitable strategy. MFish's management of the recent Seafresh 1 incident is a promising indicator for the future of marine biosecurity.

B.7 Subterranean termites in Otorohanga

B.7.1 Background

The subterranean termite, *Coptotermes acinaciformis,* was first reported in Otorohanga in 1990 after a resident observed winged insects emerging from a doorjamb. The termite is thought to have arrived in hardwood power poles imported from Australia in the late 1950s. Subterranean termites are social insects that live in large underground colonies, and feed on wood and wood products such as power poles, houses constructed of wood, fence posts, railway sleepers and tree stumps.

The Ministry of Forestry removed and fumigated two power poles and injected several active termite runs with insecticide, with the expectation that the infestation would decline into extinction, but evidence since has revealed otherwise. Following the discovery of further termite activity in 1994, 1996 and 1997, response measures using methods that in the past had proven successful in eliminating other termite infestations in New Zealand, failed. MAF (responsible for managing the termite infestation since April 1998) have since commented that 'the eradication responses… were the most appropriate at the time', and attribute complications in termite eradication to the nature of the undulating terrain in the area of infestation.

B.7.2 Current eradication response

MAF carried out a delimiting survey in March 1999 and found termite activity on nine properties within a concentrated area of approximately 1.4 hectares. On the advice of CSIRO termite scientists, MAF pursued a new response programme for Otorohanga, based on a baiting system recently developed by Dow AgroSciences and used successfully on this species in Australia. The system employs hexaflumuron, an insect growth regulator that prevents termites from moulting, resulting in death and eventual elimination of the colony.

The elimination programme, carried out in collaboration with the Otorohanga District Council, and contracting assistance from Vigil Forest Health Advisory Services and Australian pest control company Pestforce, began in November 1999, when three potentially infested power poles were removed and burned, and approximately 300 above- and below-ground bait stations were placed on seven properties. The termites feed on the hexaflumuron bait, return to the colony and send nest mates back to the bait stations to feed. Once they start feeding colony decline begins, but the time taken for decline varies, and it may be two years before the colony is fully eliminated.

Early results have been encouraging – no live termites or new evidence of termite activity have been found either in bait stations or on monitored properties since 18 February 2000 (a nine month period).

B.7.3 Prior eradication responses

There has been criticism over the choice of eradication process carried out in 1990, and it is thought likely to have contributed to the ongoing termite problem.[58] When termites were rediscovered in Otorohanga in 1994 a 'full survey' was carried out, but during the course of subsequent control work termite activity was discovered in an adjoining property outside the identified 'risk' area.

The failure by the Ministry of Forestry, when termites were rediscovered in a tree stump in 1996, to carry out a full delimiting survey to determine the extent of the termites' spread in the area could be seen as an oversight, especially considering the history of the problem.[59] If there was any possibility of continuing termite presence in the area it might have been wise to carry out a full delimiting survey to determine this, regardless of the amount of effort involved and the concern that might be caused to local residents in mounting such a search. If the full extent of the termites' spread had been established earlier, then proper steps could have been taken to ensure that all infested residents were informed in the earliest instance possible. Even if the current baiting system were not available at the time, and measures of treating the infestation were the same as those previously tried and failed, it is likely that a more extensive attempt at eradication would have been better than the limited treatment undertaken. In addition, affected residents (and perhaps those neighbouring residents not yet affected – see below) could have taken preventative measures sooner, and might have deterred further spread of the termites.

B.7.4 Communication

Concerns have been raised that, although residents whose properties were known to be directly affected by termites were kept informed by the relevant agencies, neighbouring residents were not told of the termites' continuing presence – either by the relevant agencies or by their known affected neighbours. MAF have stated that, under the conditions of the Privacy Act 1993, 'it is not the Ministry's responsibility to convey any details to any persons beyond those immediately affected'.[60]

[58] *Memo from Regional Manager, Northern Forest Protection/QA, Ministry of Forestry to General Manager, Operations, Ministry of Forestry, 10 May 1994.*

[59] *Letter from New Zealand Forest Research Institute to Ministry of Forestry, 28 Nov 1996.*

[60] *Letter from MAF to Residents Against Subterranean Termites, 31 May 2000.*

Neighbouring residents were under the assumption that the termites had been successfully eradicated with past treatments, and were unaware of the ongoing termite infestation in the area. Had these residents been fully informed of the proximity of the infestation, they could have taken appropriate measures to deter the spread of the termites' range. Some residents had in that time carried out house renovations (one household obtained a bank loan for renovations, which included installing a large number of railway sleepers in their garden) that may have exacerbated the situation, considering a termite's diet.

It was not until MAF carried out the full delimiting survey in March 1999 that a number of residents were newly informed that their properties were infested by subterranean termites. Although the Otorohanga District Council was aware that the Ministry of Forestry were monitoring the site through the 1990s, it was also unaware that there was an ongoing termite problem. MAF convened a meeting in Otorohanga with interested parties in August 1999 to discuss the situation. Environment Waikato stated that MAF should deal with the termite incursion in Otorohanga because it was principally a border control responsibility, rather than a regional council responsibility. As mentioned above, a new termite elimination programme, headed by MAF, began three months later.

Since the new elimination programme began in November 1999, MAF have kept affected residents informed of operational progress, including the distribution of an information brochure to residents in the area in April 2000.

B.7.5 Compensation

The affected residents have become increasingly frustrated, not only over the length of time the infestation has been going on and the lack of forthcoming compensation, but also over the falling value of their properties, the inability to sell their homes and the difficulties thus far in eradicating the termites. There is concern over the length of time it will take for their property values to rise if and when the termites have been eradicated, and the worth of that guarantee, considering the ongoing problems over the last decade.

Some residents have been seeking compensation from central government 'for personal losses and devaluation of property over nine years of ineffective action',[61] but under the Biosecurity Act 1993 compensation in this case is only payable where the 'exercise of powers' causes verifiable loss as a result of damage to or destruction of a person's property (section 162A (1)). There are no provisions in the Act for compensation other than this, and the Minister for Biosecurity informed an affected Otorohanga resident that 'ex-gratia payments of this kind could create an unacceptable precedent…'.[62] The termite damage is not covered by insurance.

Some of the affected residents have set up a community representative group, Residents Against Subterranean Termites (RASTS), which is challenging the compensation decision, arguing that their situation is unique in that the Crown has put them in 'an impossible situation by… mishandling the eradication process'. A sub-committee of the Local Government and Environment Parliamentary Select Committee is to discuss matters surrounding the ongoing termite infestation with some affected Otorohanga residents, the Otorohanga District Council and MAF.

B.7.6 Conclusions

There appears to have been a lack of proper risk assessment/ management by agencies in the past, which resulted in a lack of thorough delimiting surveys and contributed to the ongoing nature of the problem. Decisions may have been made on the assumption that because past attempts at termite eradication around the country had been mostly one-off and successful, that the same would hold for Otorohanga.

The termite incursion in Otorohanga highlights the need for improved communication systems between responsible agencies and those affected or at risk of being affected, so that all possible measures can be taken to mitigate the threat posed by the incursion. Also highlighted is the need for improved communication between central government agencies and local authorities, arising out of the previous Ministry of Forestry's involvement in this incursion. The monitoring process will continue for at least another two years and MAF state that they will maintain contact with individual affected residents at least once per year or as needed.

[61] *http://www.ew.govt.nz/whatshappening/mediareleases/termites.htm.*

[62] *Letter from the Minister for Biosecurity to Otorohanga resident, 29 Feb 2000.*

alien invasive:	species brought from another country and subsequently naturalized
arboviral disease:	disease caused by a virus borne and transmitted by an arthropod
beneficiary:	a person receiving benefits from the biosecurity system
CBD:	Convention on Biological Diversity
delimiting survey:	a survey to determine the extent and distribution of an organism
disease:	the manifestation of an infection by a pathogen on a particular host in a particular environmental setting. In the context of biosecurity, management of disease refers to the management of pathogens that give rise to disease
dunnage:	light material stowed among and beneath cargo to keep it from damage
ERMA:	Environmental Risk Management Authority
exacerbator:	a person aggravating or adding to a biosecurity problem
exotic organism:	an organism that is not established in any part of New Zealand
hapü:	family or district groups, communities
incursion:	invasion by an exotic organism
indigenous:	produced by, or naturally belonging to, a particular region or area
iwi:	tribal groups
kaimoana:	food from the sea
kaitiakitanga:	the responsibilities and kaupapa, passed down from the ancestors, for tangata whenua to take care of the places, natural resources and other taonga in their rohe, and the mauri of those places, resources and taonga

kaumätua:	elders, decision-makers for the iwi or hapü
kaupapa:	plan, strategy, tactics, methods, fundamental principles
kuia:	respected older women in the hapü or whänau
MAF:	Ministry of Agriculture and Forestry
mana:	respect, dignity, status, influence, power
mauri:	essential life force, the spiritual power and distinctiveness that enables each thing to exist as itself
MFAT:	Ministry of Foreign Affairs and Trade
MFish:	Ministry of Fisheries
MoH:	Ministry of Health
NPMS:	national pest management strategy
pest:	any noxious or destructive species
quarantine:	confinement of organisms or organic material that may be harbouring pests or unwanted organisms
rähui:	protection of a place or resources by forbidding access or harvest
rangatiratanga:	rights of autonomous self-regulation, the authority of the iwi or hapü to make decisions and control resources
risk:	a measure of the probability and severity of an adverse effect
rohe:	geographical territory of an iwi or hapü
RPMS:	regional pest management strategy
runanga:	committee of senior decision-makers of an iwi or hapü
tangata whenua:	people of the land, Maori people
taonga:	valued resources, assets, prized possessions both material and non-material
tapu:	sacredness, spiritual power or protective force
wähi tapu:	special and sacred places
weed:	herbaceous plant not valued for use, growing wild, and regarded as hindering the growth of superior vegetation
whakapapa:	genealogy, ancestry, identity with place, hapü and iwi
whänau:	family groups
WTO:	World Trade Organisation

Auckland Regional Council (ARC) (no date). *Friendly Alternatives: plants to use in place of common plant pests.* ARC, Auckland.

Biosecurity Council. 1999. *Draft Biosecurity Research Strategies for New Zealand*. Biosecurity Council, Wellington.

Biosecurity Council. 2000a. *Biosecurity Research Areas for New Zealand*. Biosecurity Council, Wellington.

Biosecurity Council. 2000b. *Towards a Biosecurity Strategy for New Zealand*. Biosecurity Council, Wellington.

Budd, K. 2000. *Review of Biosecurity Influences of the Last Decade*. A background report prepared for the Parliamentary Commissioner for the Environment, Wellington.

Clough, P., Barnett, R. and Gale, S. 2000. *The Marginal Value of Conservation*. New Zealand Institute of Economic Research, Wellington.

Cole, M. 1999. Examining the environmental case against free trade. *Journal of World Trade* 33(5): 183–196.

Cranfield, H.J., Gordon, D.P., Willan, R.C., Marshall, B.A., Battershill, C.N., Francis, M.P., Nelson, W.A., Glasby, C.J. and Read, G.B. 1998. *Adventive Marine Species in New Zealand*. NIWA Technical Report 34, Wellington.

Crump, D. 2000. *A basis for allocating biosecurity (agriculture and forestry) costs between the private sector, the Crown and producers.* NZARESI Conference.

Department of Conservation (DoC). 1999. *Post-election brief to the Minister for Biosecurity*. DoC, Wellington.

Downes, D. 1999. *Integrating implementation of the Convention on Biological Diversity and the Rules of the World Trade Organisation*. IUCN, Gland, Switzerland.

Environment Waikato. 1999. *Annual Report 1998 – 1999*. Environment Waikato, Hamilton.

Green, W. 2000. *Biosecurity Threats to Indigenous Biodiversity in New Zealand – An analysis of key issues and future options*. A background report prepared for the Parliamentary Commissioner for the Environment, Wellington.

Guruswami, L. 1998. The Promise of the United Nations Convention on the Law of the Sea, Justice in Trade and Environmental Disputes. *Ecology Law Quarterly* 25(2): 189.

Hawke, G. (ed.) 1997. *Guardians for the Environment*. Institute of Policy Studies, Wellington.

Hearnden, M. 1999. *A Health Risk Assessment for the Establishment of the Exotic Mosquitoes Aedes camptorhynchus and Culex australis in Napier, New Zealand*. Report to the Co-ordinator, Environmental Health Programme, Community Health, Healthcare Hawkes Bay, Napier.

Hosking, G. 2000. *Biosecurity Risk Mitigation for Imported Cars from Japan – Best Practice*. A report prepared for Japan Quarantine Inspections. BioSecurity Services Ltd., Rotorua.

IUCN. 2000. *IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species*. IUCN – the World Conservation Union, Gland, Switzerland.

Kay, B.H. 1997. *Review of New Zealand Programme for Exclusion and Surveillance of Exotic Mosquitoes of Public Health Significance*. A report to the Ministry of Health, Wellington.

Knetsch, J. 2000. *Environmental valuations and standard theory: behavioural findings, context dependence and implications.* The International Yearbook of Environmental and Resource Economics 2000/2001: A survey of current issues. Edward Elgar, Cheltenham, UK.

Mack, R.N., Simberloff, D., *et al*. 2000. Biotic Invasions: Causes, Epidemiology, Global Consequences, and Control. *Ecological Applications*. 10(3): 689–710.

Maguire, T. 1994. Do Ross River and dengue viruses pose a threat to New Zealand? *New Zealand Medical Journal* 107(989): 448–50.

Matheson, A. 2000. Biosecurity advisory and consultative groups: a health check. *Public Sector*, 23(1): 14–18.

Ministry for the Environment (MfE). 1997. *The State of New Zealand's Environment, 1997*. Ministry for the Environment, Wellington.

Ministry for the Environment. 2000. *Bio-What?* Preliminary Report of the Ministerial Advisory Committee. Ministry for the Environment, Wellington.

Ministry of Agriculture and Forestry (MAF). 1999a. *Post-election brief to the Minister of Agriculture*. MAF, Wellington.

Ministry of Agriculture and Forestry (MAF). 1999b. *Research in Progress: 1999/2000 research objectives purchased by MAF Policy.* MAF, Wellington.

Ministry of Agriculture and Forestry Biosecurity Authority (MAFBA). 2000a. *Description of the New Zealand Ministry of Agriculture and Forestry's Biosecurity (Phytosanitary) System: Arable/Horticultural Plants and Plant Products.* MAFBA, Wellington.

Ministry of Agriculture and Forestry Biosecurity Authority (MAFBA). 2000b. *Biosecurity*. 22 (Sept). MAFBA, Wellington.

Ministry of Agriculture and Forestry Biosecurity Authority (MAFBA). 2000c. Information Paper: *Management Options for Harmful Organisms under the Biosecurity Act 1993*. MAFBA, Wellington.

Ministry of Agriculture and Forestry Biosecurity Authority (MAFBA). 2000d. Information pamphlet. MAFBA, Wellington.

Ministry of Agriculture and Forestry Biosecurity Authority (MAFBA). 2000e. *Biosecurity* 21 (Aug). MAFBA, Wellington.

Ministry of Agriculture and Forestry Biosecurity Authority (MAFBA). 2000f. *Biosecurity* 18 (March). MAFBA, Wellington.

Ministry of Health. 1997. *Exclusion and Control of Exotic Mosquitoes of Public Health Significance: A report to the Minister for Biosecurity*. MoH, Wellington.

Ministry of Health. 1999. *Towards a National Pest Management Strategy for Exotic Mosquitoes of Public Health Significance*. MoH, Wellington.

Ministry of Health. 2000. *Proposal* [to the Minister of Health] *for the Revision of the 1999/2000 Purchase Agreement*. MoH, Wellington.

Ministry of Research, Science and Technology (MoRST). 1998. *Managing a Leaky Border: Towards a biosecurity research strategy*. Report No. 81. MoRST, Wellington.

Mountford, D.O. 1998. *Biosecurity of New Zealand's marine environment in relation to the seafood industry.* Cawthron Institute, Nelson.

REFERENCES

Nairn, M.E., Allen, P.G., Inglis, A.R. and Tanner, C. 1996. *Australian Quarantine: A shared responsibility*. Department of Primary Industries and Energy, Canberra, ACT, Australia.

New Zealand Conservation Authority (NZCA). 1999. *Pests & Weeds: A blueprint for action*. NZCA, Wellington.

New Zealand Government. 1999. *New Zealand's Border: the effective and efficient management of border services*. Final report of the Border Control Review Team. New Zealand Government, Wellington.

New Zealand Government. 2000a. *The New Zealand Biodiversity Strategy: Our chance to turn the tide*. New Zealand Government, Wellington.

New Zealand Government. 2000b. *Estimates of Appropriations for the Government of New Zealand for the year ending 30 June 2001*. Vol 1, p 345. NZ Government, Wellington.

New Zealand Government, 2000c. *The New Zealand Biodiversity Strategy Funding Package*. New Zealand Government, Wellington.

New Zealand Institute of Economic Research (NZIER). 2000. *Biosecurity Review: Key Economic Issues Facing New Zealand's Biosecurity System*. A background report prepared for the Parliamentary Commissioner for the Environment, Wellington.

Parliamentary Commissioner for the Environment (PCE). 1997. *Future Directions – strategic focus for the Parliamentary Commissioner for the Environment, 1997-2001*. PCE, Wellington.

Parliamentary Commissioner for the Environment (PCE). 1999. *Setting Course for a Sustainable Future; the Management of New Zealand's Marine Environment*. PCE, Wellington.

Portney, P.R. and Weyant, J.P. (eds). 1999. *Discounting and Intergenerational Equity*. Resources for the Future, Washington DC.

Rauniyar, G.P., Winton, A.S.W., Whyte, C.E, and Cheyne, J. 1999. *Assessment of the Effects of Border Strategies at Modifying Aircraft Passenger Behaviour.* MAF Policy Project No. MSH 301. Massey University, Palmerston North.

Sinner, J. and Gibbs, N. 1998a. *A Proposed Framework for the Management of Biosecurity Risks at the New Zealand Border*. Report prepared for the Biosecurity Council, Wellington.

Sinner, J. and Gibbs, N. 1998b. *Development of a Decision-Making Framework for the Analysis and Management of Biosecurity Risks, Stage 2 Report: Current Practice in Managing Biosecurity Risks*. Report prepared for the Biosecurity Council, Wellington.

Statistics New Zealand. 1998. *New Zealand Official Yearbook 1998*. Statistics New Zealand, Wellington.

Stephens, T. 1999. *Measuring Conservation Achievement*. Department of Conservation, Hamilton.

Sutherland, O. 2000. Fragile ecosystems facing threat? *Biosecurity* 17 (Feb): 2–3. MAF Biosecurity Authority, Wellington.

Upton, S. 2000. *Technical Literacy in the Core Public Sector with Some Thoughts about Biosecurity.* A speech to the New Zealand Institute of Agricultural Science, Wellington Branch Meeting, 31 May 2000.

Weinstein, P., Laird, M. and Browne, G. 1997. *Exotic and Endemic Mosquitoes in New Zealand as Potential Arbovirus Vectors*. Occasional Paper, Ministry of Health, Wellington.

Whyte, C.E 2000. *Annual Statistics Report, 1993/94 - 1999/2000*. MAF Quarantine Sevice, Auckland.