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**Biosecurity New Zealand's Integrated Risk Management
Framework: theory and application**

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Biosecurity New Zealand's Integrated Risk Management Framework: theory and application

Purpose of the paper

The purpose of this paper is to obtain an understanding of the theoretical and practical basis of Biosecurity New Zealand's procedures for allocating resources to biosecurity issues and in particular responses to incursions of exotic pests and diseases.

This understanding will form the base for a Decision Support System (DSS) for response. This will assist decision makers by incorporating quantified values for attributes (economic, environmental, social and cultural) of different types of ecosystems containing indigenous biodiversity into cost benefit analysis of response options.

Theoretical framework

Biosecurity New Zealand's (BNZ's) current decision support tool is the integrated risk management framework (IRMF) which is "a mechanism to guide resource allocation in managing biosecurity risks across the biosecurity system" (MAF 2004) and it "represents a tool to assist in making informed and robust decisions more consistently and transparently." It fits within the Biosecurity Strategy for New Zealand (MAF 2003) and the link to the Incursion Policy Statement (MAF 2001) can be found at <http://www.biosecurity.govt.nz/bio-strategy/library/policy-incursion.htm>.

This section outlines the key features of the IRMF and then goes on to review its application on real world problems. The section ends with an update on BNZ projects aimed at improving on the IRMF.

In the BNZ context risk is defined as "the chance of something happening that will have an impact on objectives" and is measured in terms of consequence - "outcome or impact of an event" and likelihood - "probability or frequency".

Risk management is defined as the "culture, processes and structures that are directed towards realising the potential opportunities whilst managing adverse effects" Australian Standards and Standards New Zealand (AS/NZS 2004) (pp.2-4).

Biosecurity is defined as "the exclusion, eradication or effective management of risks posed by pests and diseases to the economy, environment and human health(Biosecurity_Council 2003) (p.5). 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" " (Parliamentary_Commissioner_for_the_Environment 2000) (p.9).

Risk management "involves managing to achieve an appropriate balance between realising opportunities for gains and minimising losses" (quoted from Standards Australia and Standards New Zealand, 2004, p.iv). "In general, the costs, including opportunities foregone, of managing risks should be commensurate with the benefits obtained."

The IRMF is founded on principles of:

- risk management
- effectiveness and efficiency, and
- integration.

MAF states that to be effective in allocating resources the IRMF must be:

- robust
- discriminating
- consistent (including with international agreements i.e. embody reciprocity)
- transparent
- practical, and
- dynamic.

The IRMF draws on two existing risk management frameworks - the Australia/New Zealand risk management standards (Standards Australia and Standards New Zealand, 2004) and the New Zealand food safety risk management framework Project (MOH_and_MAF 2000) and encompasses all the steps in them, but there are some deviations due to differences in level, purpose, emphasis and focus of the IRMF.

The decision support components of the framework comprise identification, assessment, and prioritisation. How these fit together can be seen from a summary of the Response Top Map (Figure 1).

The high level framework of the IRMF has seven components (MAF 2004):

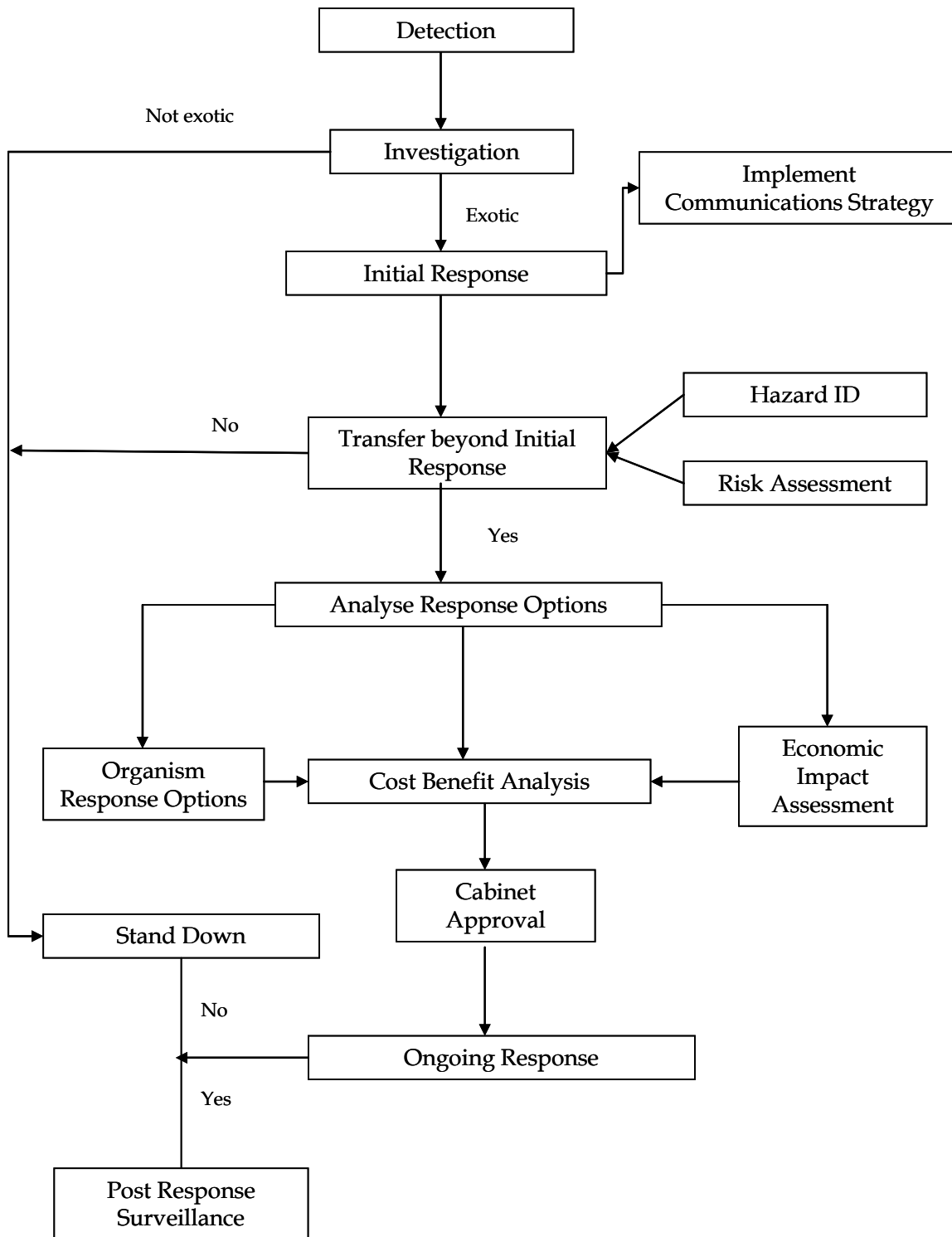
1. The **Context** within which the framework must operate encompasses three broad areas:

- a. "international and domestic legislation, agreements and standards
 - b. strategic directions, objectives and priorities for the government, society and communities, the biosecurity system, agencies and stakeholders; and
 - c. risk management principles, objectives and parameters and assessment criteria, methods and processes."
2. **Identification** of risks and a preliminary assessment of whether management options are needed. At this stage identified risks are assessed according to criteria of likelihood; consequence and acceptability; whether management is mandatory; and their management potential and urgency, using a simple scoresheet.
 3. **Assessment** of management options, including prioritisation informed by cost benefit analysis where undertaken. Criteria for assessing costs and benefits is all encompassing and includes: commercial, environmental, social, human health, Maori cultural and spiritual, and public effects, "all of which are accorded equal weight."
 4. **Prioritisation** with other risks competing for resources to determine relative priority.
 5. **Implementation** involves delivering on management options.
 6. **Communication and Consultation** with stakeholders as this "contributes to the achievement of better outcomes through not only more informed decision making, but also greater stakeholder understanding and ownership of decisions."
 7. **Monitoring and Review** to ensure the IRMF remains robust in the long term.

Within the IRMF, Cost benefit analysis may be carried out either semi-quantitatively or quantitatively.

MAF state that a key factor in applying CBA is the need for simplicity due to the particular decision making environment (for example, the need for quick decisions). Therefore, "in most cases" (p16, paragraph 6) risk management options are assessed using a semi-quantitative, simple scale scoring system.

Figure 1. Response Top Map Summary



Source: adapted from BNZ

Quantitative CBA is used "where feasible and warranted" although no guidance is given on what these terms mean in this context. The scoring system is said to provide "systematic decision making with objectivity and transparency". "It has modest resource requirements, is not overly mechanistic or dependent on quantification". It is also said to clarify trade-offs and facilitate the exercise of informed judgement. When comparing risk management options a single rating is used rather than assessing the benefit-cost for each option.

Full quantitative assessment is used when considered by MAF to provide value in decision making relative to resources and time required. The procedure follows the general 12 steps in MAF's Cost Benefit Handbook , CBA for unwanted organism or pest response options (MAF 2002). Variations include cost-effectiveness analysis and economic impact assessment. Score sheets are available to assist in considering the appropriate level of assessment and rating confidence in an assessment. Assessments can also be subject to peer review, particularly where they are quantitative.

Non-market effects add to the difficulties in applying CBA particularly for the environment and social effects. Here MAF point out a number of approaches that can be used including willingness to pay (a revealed preference technique) and stated preference techniques. Their application "must be appropriate to the context and consistent across assessments".

Uncertainty is addressed through "sensitivity analysis and scenario modelling" and may include "probability distributions of decision criteria".

Decision rules such as maximin payoff, minimax regret, index of pessimism, worst case scenarios, specification of threshold constraints and real option values may be used to inform decision makers, but they are not equally robust.

Because of the long time frame of some effects MAF state that a low positive rate or a sliding rate may be used to discount future costs and benefits or even limit the analysis to cost-effectiveness.

The criteria used by MAF for priority assessment are:

- technical
- practicality
- benefit-cost
- strategic, and
- acceptability.

Scores for each criterion are combined in a single score by use of a scoresheet. Individual scores are ordinal rather than cardinal and are used to give guidance on relative rankings of priority. Equal weights are given to each criterion, but it is stated that relative weights could be introduced in the future.

The IRMF process for assessing priority follows nine steps:

1. define the problem
2. establish the assessment panel
3. prepare background information
4. distribute information to scorers, setting deadlines for return of forms
5. scorers individually complete the scoresheets
6. scores are collated
7. and analysed
8. the panel convenes to review the scores
9. scores are revised on the basis of discussion.

The process is supposed to assist in making informed and robust decisions, rather than dictate them.

The process for determining relative priorities is as follows:

1. rank options by score
2. convene the assessment panel to discuss these rankings - here the focus is on options around the threshold and some rescaling may occur in order to reach agreement
3. finalise selection of options to implement
4. record the scores and decisions for future reference and copy to the Biosecurity Strategic Unit.

A system of escalation in decision making is used to ensure the appropriate level of responsibility is met.

Over time the implementation of the framework is expected to migrate resources incrementally towards the optimum allocation of resources.

A key task will be to review the application of the framework to determine its practicality and usefulness to decision makers.

Practical application of the IRMF

With implementation, the Integrated Risk Management Framework has drawn attention to a number of common issues that need to be addressed across different areas. These common issues are:

- What process and criteria should be used for all these decisions
- The need for improved clarity around the roles and responsibilities and decision rights.

The Biosecurity Strategic Unit is concerned with these issues, which include the transition between National and Regional, and MAF and DoC, and determining top priority pests and top priority areas and related issues regarding priorities. They all have common questions that need answering within a common framework.

There needs to be an agreed process and lack of this was found to be a weakness (David Wansbrough, Manager BNZ, *pers. com.*). According to Wansbrough the IRMF gets a five out of 10 for implementation. He says that it needs to be reinterpreted as to where it should be used; how to make it generic; and how to get agreement on the various steps.

One of the issues in implementing the IRMF is its complexity, or perceived complexity, and in Wansbrough's view one way of reducing this is to use relative values rather than try to quantify absolute values. His pragmatic view is that there will never be perfect information and decision makers have to make judgements. It is the analyst's role to make them better informed judgements. Wansbrough said that Nimmo-Bell's work during the development of the Biosecurity Strategy on allocating resources to surveillance (Bell *et al*, 2002) will be revisited by the Biosecurity Strategic Unit during the development of the Biosecurity Decision Project.

During 2005 the Biosecurity New Zealand started a number of projects running under the working umbrella name of the "End to End" project. This term was later formalised to become the Biosecurity Decision Project (BDP). The key projects included:

- Risk analysis procedures
- Incursion response system
- Import Health Standard process
- Pest Management Programme, and
- High impact pests and diseases.

It became apparent that a common framework was needed for all these areas and with the IRMF much of the framework existed. But it needed to be consolidated

and tested out to determine how much consistency could be obtained between the various decision-making areas and it needed to be able to be presented in a simple diagram.

The BDP sits on top of the other projects such as risk analysis procedures as set out above. The initial objective was to get the framework for the PDP completed within the calendar year 2006. However, this now expected to take at least another couple of months as top priority has now shifted to improve information management for the Quarantine Service.

The IRMF has been used by the response team in prioritisation during rapid decision-making processes. The main difficulty encountered was in the numbers generated for each criteria, particularly for economics (costs and benefits), where there was not the information sitting behind the values that the process ended up with to give confidence and credibility. The process attempts to make judgements without information and as a result the users cannot differentiate between options in practical application situations. The problem is that similar numbers are derived for different options. In this respect it does not seem to be helping with the decision-making process.

In the marine program which has a limited number of people resources, using IRMF failed to deliver useful results when used within a meeting timeframe. It could not differentiate different options within the sensitivity of the results.

The Animals team used the IRMF to obtain a shared understanding of priorities when looking at projects, but again it did not allow people to differentiate clearly between options.

At the end of the day decisions on responses don't use the IRMF in its entirety. Instead decisions are mainly based on subjective judgements which are not clear or apparent.

There is a real need to justify a decision not to respond and BNZ needs to communicate better on the process that leads to that decision. Currently, it may be perceived that BNZ is doing nothing when in fact a considerable amount of work is going on, but not being communicated to the public.

During the didymo process an economic impact assessment was done on the impact of didymo on New Zealand in the absence of government intervention to control its spread in 3 scenarios - low, medium and high impact (Branson and Clough 2006). The study estimated the present value impacts over 8 years at a discount rate of 10% on:

- the commercial eel fishery

- municipal, industrial and agricultural water intakes
- community, municipal and domestic drinking water
- local recreational values
- international and domestic tourism expenditure, and
- local and national existence values associated with extinction of five native species.

The results were: low impact \$57.8 million, medium \$167.2 million and high \$285.1 million with an expected NPV based on weighting the three scenarios by their relative probabilities estimated to be \$157.6 million. Potential impacts not quantified due to data limitations or materiality included:

- impacts on cultural values including customary fishing
- alluvial gold mining
- exports of used fishing and boating gear, including personal effects
- human health from eye irritation in swimmers
- injuries from slipping on rocks.

This study was completed in early March 2006 many months after the incursion became public and it did not proceed on to a cost benefit analysis of response options as the IRMF would imply. It serves as a good example of the incomplete implementation of the IRMF.

If the process is robust then it is defensible. The IRMF did not pass that test.

Initial Conclusions

Initial conclusions based on application of the IRMF in the area of Import Health prioritisation are that the process needs to be broken down into smaller chunks that people can manage (Chris Baddeley, Manager Policy BNZ, *pers. com.*, 2006). According to Baddeley a key change is to break the process into two stages, with stage 1 focused on assessing the impacts and their probabilities, and stage 2 looking at mitigation and acceptability. He also identified the need to sharpen up on the criteria and the weighting and staging. Staging relates to the assessing the biggest risks first and determining the practicality of response. Acceptability is a key issue. Baddeley's summary of the key points to be noted on the IRMF is as follows:

1. Uptake of the IRMF by BNZ has been uneven, implementation has not been good due to complexity, difficulty in understanding and people being unsure how to apply the criteria

2. Nevertheless there have been good attempts to implement it of which Import Health Standards to set priorities is an example of it being formally applied and done well. It has been used on team work programmes, such as in Policy where it was used to rank the 90 priorities identifying the top 10. It was also used to look at different options for incursion responses.
3. But it is recognised as being difficult and having shortcomings that led to the Biosecurity Decisions Project, which it is building on. This time there will be adequate emphasis on implementation, buy-in and use. The Biosecurity Decisions Project was initiated over the top of the IRMF as it was being implemented.
4. Cost Benefit Analysis (CBA) was central to the IRMF and will be central to the Biosecurity Decisions Project as well.

A focus on Marine Biosecurity

At the next level down from the BDP there is a major programme of work focusing specifically on marine biosecurity where the gaps in knowledge are particularly acute. The aim of these projects is to develop support for an integrated decision support framework for marine biosecurity. The projects are collectively referred to as the “Value Mapping Programme”. They are discrete projects which have inter-relationships to varying degrees. As the primary purpose of the projects is to develop an integrated decision support tool for assessing the risks posed by non-indigenous marine species (NIMS) there are moves to rename the programme the “Marine Biosecurity Decision Support Tool” (MBDST) programme (Management Committee recommendation, 8 June, 2006). The MBDST contributes to all the sub-projects of the BDP except the High Impact Pest and Diseases project.

The MBDST programme is funded under the Cross Departmental Research Pool (CDRP) and FRST and is jointly sponsored by BNZ and DoC with additional support being provided by Maritime NZ and MfE. It has three sub-projects under the MISPM:

CDRP – Marine Invasive Species Predictive Model (MISPM)

- SP 1 Marine Value Mapping
- SP 2 Risk Profiling
- SP 3 Decision Support Tool (Risk Assessment).

Allied to these projects are the CDRP project Biological & Cultural Impacts and this project the FRST funded Valuing Biodiversity project.

Essentially the MBDST project is about data collection whereas the Valuing Biodiversity project is about valuation.

2.4 Gaps and deficiencies

My perception is, after discussions with MAF personnel, that as an allocation tool the integrated risk management framework has proved to be too complex and sophisticated for biosecurity personnel to implement effectively. The framework itself is sound theoretically, but needs to be simplified and phased into more discreet levels depending on the stage of the incursion, its perceived impacts and consequences for eradication, control, management or accommodation. It also needs to have a communication component so that the public can take a role and be reassured that appropriate action is being taken in a timely way.

The focus of work to date in research has been on the productive sectors and in particular ensuring that agricultural and forestry production is protected against incursions of exotic pests and diseases. This is a feature not only in New Zealand but worldwide. Recently however, there has been an increasing interest in protecting indigenous biodiversity as its value in providing ecosystem services has become more apparent. In New Zealand very little information exists on ecosystem values and little work has been done to fill these gaps. There is current work that is addressing this in the marine area through value mapping on a 20 x 20 kilometre grid around the coast developing indexes for the environment, economic, social and cultural values of the marine environment. It will be several years before this information is available to policymakers. This work has yet to be started on terrestrial ecosystems.

2.5 The way ahead

This project will begin the process of developing values for a number of key indigenous ecosystems and further develop BNZ's decision support system for incursions.

2.6 Summary

Biosecurity New Zealand is well advanced in a program of restructuring biosecurity services in New Zealand. Increasing pressures on our borders through greater numbers of international movements of both people and goods

has been recognised by the government and resources have been increased to combat potentially serious incursions of exotic pests and diseases. Biosecurity New Zealand is working on improving its decision support systems and building databases of information that will help it improve decision-making to reduce the number of incursions and respond appropriately when a new pest or disease is detected. While most of the focus in the past of the detection and response system has been on the productive sectors attention is now turning to protect New Zealand's unique indigenous biodiversity. This project is a key plank in the government's strategy to protect New Zealand from incursions of exotic pests and diseases. It will start ongoing work to refine and improve information and processes.

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