Nelson City Esplanade and Foreshore Reserves – Maximising the Effectiveness of Biosecurity Management

Phil Cowan
Landcare Research
Private Bag 11052
Palmerston North 4442
New Zealand

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Nelson City Council
PO Box 645
Nelson

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Reviewed by:	*Approved for release by:*
Bruce Warburton Scientist Landcare Research	Andrea Byrom Science Leader

Contents

Summary

The Nelson City Council (NLCC), through Envirolink funding (448-NLCC11), requested Landcare Research to provide advice as to how the council could maximise the effectiveness of its biosecurity management of the esplanade and foreshore reserves, particularly through improved prioritisation of activities.

The current lack of detailed information about native and introduced plants and animals in the esplanade and foreshore reserves limits the approaches available for initial prioritisation of reserves for management. NLCC should give a high priority to more detailed plant and animal surveys of the reserves.

Animal Pests

For initial prioritization of animal pest management for biodiversity protection and restoration until better information is available, NLCC should:

- treat Cable Bay Area Nelson Haven Area and Waimea Inlet Area separately in determining priorities
- within each of these areas firstly, score reserves by
    - size (S) – less than 1 ha =1; 1-5 ha = 2; 5-10 ha = 3; >10 ha = 4
    - Predominant Habitat Form (PHF) – urban (mown area, border planning) = 1; narrow stream bank or coastal strips = 2; extensive stream bank or coastal strips = 3; sandflats, forest remnants, islands = 4
- multiply the (S + PHF) score by the Vulnerability to Threats score where, for each pest,
    - no apparent risk of animal pest to any native biodiversity value = 1
    - no apparent risk of animal pest to a key native biodiversity value(s), but risk to other elements of native biodiversity value = 2
    - indirect risk of animal pest to a key native biodiversity value(s) = 3
    - direct risk of animal pest to native biodiversity values = 4
- If there is insufficient information about individual pests, then Ure's (2002, 2003) Threats ranking should be used instead.
- add scores for the following secondary factors
    - past animal pest control at the reserve: effective control over whole area = 3; effective control over part of the area = 2; ineffective past control = 1; no past control = 0
    - other values at the site: for each major additional value – amenity, cultural, public access and recreational values – add 1 to score

This provides a provisional method of ranking sites. In the longer term, NLCC should survey the esplanade and foreshore reserves for the presence and distribution of native and introduced animals and undertake a detailed assessment of native vegetation to enable a more thorough prioritisation of sites and pest management. Once more detailed information is available, a more formal ranking of reserves for the conservation value of their vegetation and native animals should be undertaken as outlined in Appendices 2–4 and the main body of the report, and a wider set of secondary factors included in the scoring. At that time NLCC may need to adapt the advice presented inn this report to take into account the place of the esplanade and foreshore reserve in any wider biodiversity action plans developed under the Nelson Biodiversity Strategy.

Operational monitoring (i.e. to what extent has the management action reduced numbers and/or distribution of the pest) of animal pests in the esplanade and foreshore reserves should be conducted using a standardised species-appropriate technique chosen from the list provided (Appendix 7).

Outcome (performance) monitoring (i.e. to what extent has the change in pest numbers and/or distribution changed the status and/or condition of the value at risk) for browsing animals in the esplanade and foreshore reserves is probably best measured using photopoints, standardised seedling counts, and foliar browse index measurements. Outcome (performance) monitoring for predators is probably best measured using native bird species lists and transects in the larger reserves, and artificial refuges and pitfall trapping for invertebrates. Outcome monitoring may require measurement in areas not subject to pest management to act as controls for natural variation.

Surveillance for animal pests in the esplanade and foreshore reserves is best carried out using a standardised species-appropriate technique chosen from those listed in Appendix 5. Surveillance can often be undertaken as part of operational management and/or monitoring. NLCC should also consider targeted surveillance in the esplanade and foreshore reserves for high risk animal pests, such as Argentine ants.

Plant pests

For initial prioritization of plant pest management for biodiversity protection and restoration until better information is available, NLCC should:

- decide on any weed-led programmes for weeds present in the esplanade and foreshore reserves using the DOC process (Timmins & Owen 2001) to assess if the weed species present meets the feasibility criteria for a weed-led control programme (see Appendices 8, 9). Species declared as pests in the TNRPMS should perhaps be considered as priority for weed-led management.
- use the method of Timmins and Owen (2001) to rank proposed weed-led control programmes to select those that will give the best conservation return.
- for site-led programmes in the esplanade and foreshore reserves, use scores from Size (S) and Predominant Habitat Form (PHF)
- multiply by the (S + PHF) score by the Vulnerability to Threats score where, for each pest,
    - no apparent risk of plant pest to any native biodiversity value = 1
    - no apparent risk of plant pest to a key native biodiversity value(s), but risk to other elements of native biodiversity value = 2
    - indirect risk of plant pest to a key native biodiversity value(s) = 3
    - direct risk of plant pest to native biodiversity values = 4
- If there is insufficient information about individual pests, then Ure's (2002, 2003) Threats ranking should be used instead.
- add scores for the following secondary factors
    - past plant pest control at the reserve: effective control over whole area = 3; effective control over part of the area = 2; ineffective past control = 1; no past control = 0
    - other values at the site: for each major additional value – amenity, cultural, public access and recreational values – add 1 to score
    - potential of site for restoration: significant benefit to native vegetation at site likely to be achieved in 1 = >15 years; 2 = 5–15 years; 3 = 1–5 years; 4 = <1 year.

This provides a provisional method for ranking sites. For prioritising weeds within sites for management, NLCC should use the weediness scoring system developed by DOC (Owen 1997; Appendices 11, 12).

In the longer term, NLCC should survey the esplanade and foreshore reserves for presence and distribution of plant pests to enable a more thorough prioritisation of sites and plant pest management. Once more detailed information is available, a more formal site-led prioritization should be undertaken. At that time NLCC may need to adapt the advice presented in this report to take into account the place of the esplanade and foreshore reserve in any wider biodiversity action plans developed under the Nelson Biodiversity Strategy.

Operational monitoring of plant pests in the esplanade and foreshore reserves should use the annotated flow chart of Partridge et al. (2002) to guide choice of monitoring methods and the appropriate field monitoring modules.

Outcome (performance) monitoring should be done using photopoints to monitor broad changes in vegetation cover. Changes in native plant numbers, condition and/or distribution should be monitored using the same techniques described for weeds by Partridge et al. (2002). Changes in native animal numbers should be monitored using the same techniques described for animal pests. Outcome monitoring may require measurement in areas not subject to pest management to act as controls for natural variation.

Surveillance for plant pests in the esplanade and foreshore reserves is best done initially using the current system of detection during management. However, not all reserves, and not all parts of the larger reserves are likely to receive weed control, and a number of the reserves are at high risk from garden escapes. To minimize the risk of new weeds establishing at such sites, surveys of them should be repeated two yearly. Any new weeds found can be ranked in order of priority for control using the system developed by Williams and Newfield (2002).

System development

To assist NLCC with further development of issues relating to its pest management activities in the esplanade and foreshore reserves, NLCC should consider future Envirolink grant applications for:

- advice on design of appropriate operational and outcome (performance) monitoring protocols
- advice on design of appropriate surveillance protocols for animal and plant pests.

1. Introduction

Nelson City Council has produced a comprehensive Management Plan for the esplanade and foreshore Reserves it administers. The Plan sets out the broad objectives and policies for the reserves with a range of specific actions for each site, but does not indicate relative importance of the various reserves for local or regional biodiversity conservation or biosecurity protection. The Nelson City Council (NLCC), through Envirolink funding (NLCC11), requested Landcare Research to provide advice as to how the council could maximise the effectiveness of its biosecurity management of the esplanade and foreshore Reserves, particularly around prioritisation of activities. This would assist the Council to move to an outcome-based focus for the plant and animal pest management activities associated with management of these reserves, and so ensure that management achieves the desired outcomes in terms of resource protection rather simply reduction in pest numbers and/or distribution. The ability to report on outcomes will assist NLCC in meeting its obligations under the Resource Management Act 1991, the Local Government Act 2002 and the Reserves Act 1977.

2. Background

Nelson City Council administers 43 esplanade and foreshore reserves. These have been subject historically to various types and frequencies of pest management targeting both animal and plant pests. A management plan for these has recently (2007–08) been through a public consultation process and been signed off by council. The plan spells out objectives, policies and overall priorities for plant pest (= weed) control (section 3.8) and animal pest control (section 3.9).

For animal pests the objectives are:

- To minimise the adverse effects of animal pests in reserve areas that have high natural values and are important wildlife habitats
- Good habitats for valued wildlife and increased biodiversity

These objectives are to be achieved through action under a set of policies:
3.9.1 For reserve areas with high conservation values and/or those with natural reinvasion barriers (e.g. islands)

- undertake pest control
- support and assist community pest control groups
- consider entering partnerships with other agencies and community groups such as Landcare groups and DOC for joint pest control initiatives

For weeds the objectives are:

- To ensure sufficient control and management of invasive weeds in new and existing reserves to protect vegetation and other reserve values
- To minimise further weed encroachment in reserve areas

These objectives are to be achieved through action under a set of policies:
3.8.1 Undertake regular weed surveillance and monitoring on all sites
3.8.2 Establish a priority list for reserve weed control taking into consideration value of the site and severity of weed threat
3.8.3 Actively manage invasive weeds at sites identified as high priority
3.8.4 Develop and initiate an anti-garden-weed dumping in reserves education and enforcement programme generally or for specific problem locations

The Esplanade and Foreshore Reserves Management Plan objectives indicate the need for both pest- and site- focused activity within the overall plan. Policies 3.8.1–3 indicate further needs:

For animal pest management:

- Appropriate surveillance and monitoring techniques and data management systems
- A system to identify and prioritise sites of high natural value and importance as wildlife habitat
- Appropriate systems for operational and outcome monitoring of animal pest management.

For weed management:

- Appropriate surveillance and monitoring techniques and data management systems
- A prioritisation system that takes both severity of weed threat and site value into account
- Appropriate systems for operational and outcome monitoring of weed management.

Effective pest management involves deciding (i) where to do pest management; (ii) what pest to target; (iii) how to do pest management (methods, frequency, intensity, scale); and (iv) how to measure success. This project focuses on decisions (i), (ii), and (iv) in the context of the management of esplanade and foreshore reserves, but the principles espoused are applicable to all of the NLCC pest management activities.

3. Objectives

- To adapt or develop appropriate systems that NLCC can use to prioritise the esplanade and foreshore reserves for pest management
- To advise NLCC on appropriate outcome and operational monitoring and surveillance of pests and associated pest management activity.

4. Methods

Documents pertinent to the project were provided by NLCC. A formal meeting was held with NLCC staff on 21 February 2008 to discuss and confirm the scope of the project and desired outputs. A second meeting was held with NLCC staff on 28 May 2008 to review options for proposed prioritisation systems and progress with the overall project. A range of pertinent published and unpublished material was consulted in the preparation of the advice (Appendix 1).

General comments on pest management

Some plants and animals are considered pests because they impact on a value (e.g. conservation, production, amenity) in ways that are judged harmful or unwanted. The most effective pest management focuses on those species that have the greatest impact on the values of interest, and reduces pest impacts below a predetermined threshold at which impacts are considered acceptable. In some cases, local elimination may be the most effective strategy, but only if the appropriate criteria for eradication are met (see Parkes 2005). Often, however, insufficient information is available about the identity of the key pests and the nature of the relationship between pest density and impacts, and robust methodologies are lacking for measuring benefits of pest management in terms of the value of concern not just the reduction in pest numbers or distribution.

Pest management should not focus on the pest unless the objective is eradication. Because eradication is mostly not achievable, most pest management is sustained control. Resource protection is the goal of sustained control and to be effective it requires knowledge of the relationship between pest impacts and pest density – otherwise pests may be killed with little benefit.

Pest management can be either pest focussed or site focussed. In the former one or more particular pests are targeted (e.g. possums, gorse) usually at multiple sites, whereas in the latter one or more pests are targeted at individual sites that meet a particular set of criteria (e.g. contain rare or endangered native species and/or habitats). In either case, there should be clearly stated goals set at the outset of any management activity, both in terms of pest management and in terms of the value to be protected.

Monitoring of pest management is undertaken to answer two questions. Firstly, to what extent has the management action reduced numbers and/or distribution of the pest? Secondly, to what extent has the change in pest numbers and/or distribution changed the status and/or condition of the value at risk. The former is usually called operational monitoring, and the latter outcome (performance) monitoring. The management action may have a predetermined target (e.g. reduction of possums to <5% trap catch or reduction in the extent of weed infestation by 50%). Such targets may be best guesses, but if the relationship between pest density and impacts is known, then managers can make more cost effective decisions about strategic and operational issues in mitigating pest impacts. In the absence of pest density-impact information, managers often adopt a precautionary approach and reduce pests as much as possible or they adopt a pragmatic approach and reduce pests to the extent that funding permits. However, if operational and outcome monitoring are not undertaken then funding may be wasted, and the evidence to support ongoing control will be lacking. Some useful approaches for use in small reserves can be found at http://www.sanctuariesnz.org/monitoring.asp and in Janssen (2004).

Operational monitoring of pest management activities is currently undertaken by councils, such as NLCC, using various methodologies, and frequencies and intensities. Operational monitoring aims to provide an estimate of the proportional changes in the pest population as a consequence of the control action. It is essential to demonstrate that the control actions undertaken have had the desired effect on target pests (e.g. reduction in numbers or distribution).

By contrast, outcome (performance) monitoring, which provides an estimate of the effectiveness of pest control for protecting a defined resource (e.g. native biodiversity), is currently rarely conducted by councils despite it being essential for them to meet and report on achievements in terms of the Resource Management Act and the Biosecurity Act. This is partly because outcomes are difficult to define in ways that lend themselves to ready measurement, and so outcome monitoring is often costly and trends in the condition of biodiversity may not show themselves for several years. Outcome monitoring also usually requires measurements before control is imposed and/or a matched site where there is no control to take into account natural fluctuations in animal numbers in response to climate, annual variation in fruiting, etc.

Pest management is often constrained by available funding and so effective prioritisation is a key part of the planning process. However, prioritisation is very difficult if there is inadequate baseline information about what pest species are present, the extent of pest infestations and pest impacts. Appendix 2 outlines a suggested process for NLCC that would incorporate prioritisation within the broader planning process. There are two main approaches to allocation of resources to pest management, and to a large extent these dictate how prioritisation is undertaken. Cost minimization involves deciding what pest management is to be undertaken and then working out how that control can be achieved most cheaply (i.e. the budget is flexible). Benefit maximization involves deciding on how much money and/or resources will be applied to pest management and then working out how the maximum benefit can be achieved from those inputs (i.e. the budget is fixed).

Individual reserves cannot be considered in isolation from each other or from surrounding habitat. Adjacent, small reserves, for example, may act as corridors to larger areas of habitat, and so have greater joint value than individual value. Surrounding habitat is frequently an ongoing source of pests that reinvade areas under control, and cost-effective control of pests in reserves may require that the boundaries of pest management extend well beyond the reserve itself.

Recently, pest management has started to move from a single species focus to the management of multiple pest threats at sites. This change recognises the interactions between pests, and between animal and plant pests. For example, possum control in native forest may be followed by increases in rat numbers; rabbit control may be followed by increased weed problems.

Often the initial focus of pest management is to halt a decline in the condition of a valued resource or site. Ultimately the objective may be enhancement/restoration of the condition and value of that resource or site. Restoration needs to a critical feature of management plans, more so for plant pest than for animal pest management. This is because in the absence of total weed control, one weed often replaces another, with little net benefit for biodiversity. Restoration plantings of native species may also help suppress future weed problems.

Prioritisation systems

Existing Pests

Many prioritisation systems have been developed for ranking management units, sites or reserves. Such prioritisation systems generally operate through a primary assessment of the botanical and wildlife conservation value of the site. Many regional councils have used such systems to identify high priority sites for biodiversity protection. For example, Greater Wellington Regional Council's Key Native Ecosystems are natural features on private land that are exceptionally important in terms of their ecological value and/or biodiversity.

The first step in priortisation of sites for biodiversity value has usually been to sort areas in relation to their wildlife and botanical values. The most commonly used prioritisation systems have been those of Elliott and Ogle (1985, Appendix 3) and Shaw (1988, Appendix 4), respectively. For assigning individual taxa to threat categories (e.g. national critical, nationally endangered, etc), DOC has recently published an updated threat classification system and manual (Townsend et al 2008). DOC's strategic plan for managing invasive weeds (Owen 1998) encompasses both site-led and pest-led prioritisation. A more recent general approach is that of Lee et al. (2005) who advocate use of species occupancy, environmental representation and native dominance to identify sites of high conservation value.

This approach of according high priority to biodiversity that has high 'value' underlies the four priorities in the National Policy Statement on Biodiversity on Private Land:

1. To protect indigenous vegetation associated with land environments, (defined by Land Environments of New Zealand at Level IV), that have 20 percent or less remaining in indigenous cover
2. To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity
3. To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2
4. To protect habitats of acutely and chronically threatened indigenous species.

Previously, NLCC has commissioned several assessments of sites of importance in the city and surrounding area. Ure (2002, 2003) used a set of criteria based partly on Myers et al. (1987) to rank NLCC conservation reserves based on conservation value (rarity of species, representativeness, size, connectivity) and plant and animal threats. Harding (2000, 2004) used criteria from the proposed Nelson Resource Management Plan to provide a preliminary assessment of additional areas of significant conservation value within Nelson city. Only a few of the esplanade and foreshore reserves were included in Ure's and Harding's assessments. Their assessment also only dealt in detail with vegetation and habitat values and made little comment on native animals.

The next step, having scored areas for wildlife and/or botanical value, is usually to assess vulnerability of the conservation values to the threatening agent (e.g. animal pest(s) or weed (s)). This may be done by considering the impacts of animal or plant pests jointly or separately. Vulnerability (impact or risk of impact) has been used to weight the primary conservation value scores (e.g. Parkes 1990). Other factors may also be used to weight the primary conservation value scores; for example, Parkes (1990) included a weighting for the differing impacts of goats on stability/resilience of various ecosystems. A range of secondary sorting criteria are then usually applied (Parkes 1990; DOC 1994).

The general process of prioritisation (Warburton 1993) thus consists of

Ranking sites for conservation value of
- wildlife
- vegetation

↓

Weighting conservation value score (higher of the wildlife or vegetation score, or using combined score) by vulnerability to threats
- Animal pests
- Weeds

↓

Applying secondary sorting criteria

↓

Final rank

For the esplanade and foreshore reserves, there is also a need to take into account the Tasman-Nelson Regional Pest Management Strategy (TNRPMS). This indicates prioritisation of pest-management effort to sites of high public value, selected using criteria that assess ecological, amenity, cultural, public access and recreational values as well as history, feasibility, and cost of pest control (although the details of the system for conducting the prioritisation are not presented).

New Pests

Effective management of the esplanade and foreshore reserves also requires their protection against future pest problems, both new to the region and new to specific reserves. This requires a structured programme so that new pests are detected as soon as possible (surveillance), their potential impacts can be assessed (risk assessment), and appropriate management actions instigated. New animal pests are uncommon, so animal pest risk assessment is relatively uncommon. Weeds are different, mainly because New Zealand has so many introduced plants whose potential pestiness is not known. DOC's weeds risk assessment system (Williams & Newfield 2002) is a good example of how to prioritise new and emerging plant species for management, and for choosing the appropriate type of management. Systems for prioritisation of animal pests versus plant pests, expenditure on pest management versus monitoring versus surveillance, and between different values, are not yet well defined.

Prioritising the Esplanade and Foreshore Reserves

The forty-three reserves vary greatly in size, from 0.08 to 43.93 ha, with sixteen being < 1 ha in size, sixteen 1–5 ha, six 6–10 ha, and six > 10 ha. In the management plan they are grouped into three catchment-based groups – Waimea Inlet area, Nelson Haven area, and Cable Bay area. The

Waimea Inlet reserves are mostly small (only 2 out of 20 are > 10 ha), clustered around 4 streams, and fairly strongly inter-connected, with almost all being within 2 km of another reserve. The Cable Bay reserves are also small (1 out of 8 is > 10 ha), and strung out in two clusters about 2.5 km apart along a single stream. The 15 Nelson Haven reserves are mostly close together and strung out along a single stream and its tributary that runs through the city.

The connectivity between reserves within the three areas suggests there could be advantage in a coordinated plan for managing pests within each area to, for example, to help minimize reinvasion from upstream and neighbouring reserves.

Two islands are included within the set of esplanade and foreshore reserves. Islands have additional advantages for biodiversity protection and restoration because there are often greater possibilities for pest eradication and subsequent biodiversity enhancement. Oyster Island has a restoration plan developed in conjunction with NLCC. Haulashore Island would benefit from a similar formal restoration plan.

The esplanade and foreshore reserves are also likely to be part of wider biodiversity action plans developed under the Nelson Biodiversity Strategy 2006–2009. These wider plans have the potential to influence priorities for pest management in the esplanade and foreshore reserves. The adoption of a prioritisation process for the esplanade and foreshore reserves also has implications for 2008 Management Plan, particularly in relation to actions listed against individual reserves.

Animal Pests in the NLCC Esplanade and Foreshore Reserves

Excluding fish, the TNRPMS lists Argentine and Darwin's ants, rooks, magpies, possums, feral cats, lagomorphs, and mustelids as pests requiring some form of control. However, there is almost no information about animal pests in the 43 reserves covered by the Esplanade and Foreshore Reserves management plan (this lack of information was also noted by Lawless and Holman 2006), and almost no control targeted at animal pests. Predator control occurs on Haulashore and Oyster Islands as part of separate restoration plans, and at Paremata Flats by a community group. Birds on Airport Peninsula are mentioned for the risk they pose to aircraft. Detailed plant and animal surveys are available for only a few of the esplanade and foreshore reserves (Harding 2000, 2004; Ure 2002, 2003).

Given the absence of baseline information, the first step towards prioritisation of pest animal management should be to survey the esplanade and foreshore reserves for presence and distribution of native and introduced animals. The cheapest option would be to do this using suitable summer students, under appropriate supervision.

The most likely animal pests in small reserves are rodents, wasps, and ants. In larger reserves, and where small reserves adjoin larger areas of scrub or bush, possums, rabbits, ferrets, stoats and feral cats may also occur or make temporary use of the reserves. Only the largest NLCC reserves with extensive bush may harbour pigs, goats, and deer. Introduced birds are likely to occur in most reserves, but their impacts on native biodiversity are poorly known (Forsyth et al. 2002), although their role in dispersal of weed seeds is well documented (e.g. Allen & Lee 2001).

Surveillance

Surveillance is taken here to mean confirmation of the presence/absence of pests. A range of techniques are available for surveillance of animal pests (Appendix 5). Many of these are also used in a more formal way for monitoring (e.g. NPCA trap catch protocol for possum monitoring 2008). A few surveillance/monitoring techniques are discussed briefly by Ure (2002, 2003). Some of the techniques require trained staff, for example, to recognize different tooth marks or footprints. Regardless of the technique used, the key to obtaining useful data is standardisation of method and training of staff (if necessary), that is the same method is used for repeated surveys, and repeated surveys are carried out at the same time of day and year, etc. It is important to record absence of a species from a survey as well as presence (i.e. if rodents were surveyed and rats but no mice were caught), because no surveillance device has perfect detection ability and therefore even zero detection has a level of uncertainty.

Prioritisation

Detailed information about natural values is currently lacking for most of the esplanade and foreshore reserves, so the comprehensive scoring systems of Shaw and Elliott and Ogle cannot be applied at this time. Those systems may also be of limited use for the esplanade and foreshore reserves because the generally low biodiversity values of the reserves would result in little power to discriminate between them. However, they may have applicability to NLCC’s wider suite of reserves.

The need to prioritise esplanade and foreshore reserves could be addressed by use of a simpler process. The system used by Ure (2002, 2003) to score conservation values for NLCC, or a variation thereof, may be sufficient in the interim until better baseline data on biodiversity and pest status of the esplanade and foreshore reserves are available. Ure used a system based on assessment of rarity, representativeness, size, connectivity, threats, and potential for restoration (Appendix 6).

Rarity in Ure’s system is a simple count of the number of species present at a site that are on a threatened species list. This is probably not a very useful discriminatory measure when considering native animals in the esplanade and foreshore reserves, but it may have some relevance to native plants (Ure used the NZ Botanical Society Threatened Plants list). Appendix 1 of Lawless and Holman (2006) lists native plants at risk of extinction in Nelson City and could be used to assign a botanical rarity score to reserves. For native animals, species lists of native birds sighted at each reserve may suffice initially as they are readily observed, and native reptiles and selected native invertebrates could be surveyed at a later stage and then included in an assessment of rarity.

Representativeness in Ure’s system is largely about local/regional significance and broadly scores vegetation and wildlife characteristics within a broader context of ecosystems. Higher scores reflect not only significance in terms of local/regional habitat/vegetation types/ecosystems but also that more highly ranked sites are less modified or damaged. The discriminatory power of this criterion may be low for the esplanade and foreshore reserves and the nature of the habitat and/or the extent of native vegetation cover may provide a more pragmatic discriminatory measure (see comments below).

Size is used by Ure as a criterion to reflect the potential of a site to hold the range of native plants and animals expected for the vegetation type/habitat/ecosystem.

Connectivity is a measure of connection to other areas of native habitat and/or of a site as part of a larger landscape. Adjacent sites that are within the foraging or dispersal distances of native animals and plants have additional value because they may jointly support greater diversity or higher densities of native plants and animals than each reserve alone. Ure’s scoring system is too coarse to be used for the esplanade and foreshore reserves. The relative importance of connectivity versus size is likely to vary between species; for example, connectivity is important for kokako populations (B. Burns pers.comm.) but not for NZ robins (Boulton et al 2008).

Potential for restoration is used by Ure as a criterion to represent the (subjectively) estimated time till significant conservation benefit would accrue from appropriate management.

Size and dominance of native species are often used as pragmatic measures of conservation importance, based on the well-recognized assumptions that there is a relationship between species numbers and land area, and between extent of native vegetation and diversity of native animals. All things being equal, therefore, conservation value is considered higher for larger areas than smaller ones and for areas dominated by native vegetation rather than mixed vegetation or no native vegetation. Thus, in the absence of detailed information about native plants and animals, the conservation value of esplanade and foreshore Reserves might be ranked simply by (i) size, (ii) % cover of native vegetation and (iii) connectivity.

Once conservation values have been ranked there is a need to consider vulnerability and an appropriate set of secondary sorting criteria. Vulnerability and secondary criteria are relevant in all ranking systems.

Vulnerability

Vulnerability of a site or asset is a measure of the potential impact a pest might have on it. Ideally it should be scored for each animal pest at a site, but in the absence of detailed information a subjective joint assessment across all pests could also be used. Parkes (1990) provides a useful method of weighting.

0. No apparent risk from the pest to any conservation value.
1. No apparent risk from the pest to the primary value(s), but risk to other elements of conservation value not critical in the initial ranking. For example, a site may have an endangered bird that makes a major contribution to ranking of the site; that bird may not be threatened by a particular pest (e.g. goats), although goats may impact on native vegetation at the site.
2. Indirect risk from the pest to primary value(s). For example, goats reduce vegetation ground cover which may increase stream siltation and so affect native fish or frogs
3. Direct risk. For example, the pest is a major predator of native birds whose presence at the site determines its high ranking.

If insufficient information is available for individual pests, then Ure’s (2002, 2003) Threats ranking provides an alternative approach. Ure considered risk of short-term deterioration of the conservation value(s) without management as; not apparent or not important (risk = 1), occurring slowly or with minor impact (risk = 2), occurring but environment is resilient (risk = 3), happening quickly or with long term impacts (risk = 4). Ure also included scoring for level of management intervention required, separately for plant pests and animal pests, as 1 = low, 2 = moderate, 3 = high, where ‘level’, though not defined, appears to reflect inputs/costs.

Secondary sorting criteria

Secondary sorting criteria may be evidence based or may involve expert (subjective) opinion. They include (in no particular order):

Declaration of the animal as a pest in the TNRPMS. A suggested scoring of these is total control pests = 4; regional surveillance pests = 3; containment pests = 2; progressive control pests and boundary control pests = 1. The reasoning for this ranking is that the goal for total control pests is eradication (and eradication, all things being equal, has a higher priority than other forms of management); early action on regional surveillance pests may present later need for extensive control; containment limits need for future expanded pest control; progressive control and boundary control limit current impacts.

Urgency. This criterion reflects the likely differing outcomes for conservation value(s) of the timing of management relative to the current situation. Parkes (1993) used scores of 1 = control not urgent (implying no major change in condition of the conservation value if control was delayed) to 3 = control urgent (implying as major change in condition of the conservation value if control was delayed).

Level of management. As part of the process for scoring threats, Ure included a criterion about the level of management required from 1 = low to 3 = high, where 'level', though not defined, appears to reflect inputs/costs.

Past history of control. Areas where past control has been successful should rank higher than areas where control has been ineffectual or no control has been carried out. Parkes (1990) suggested effective control over whole area = 3; effective control over part of the area = 2; ineffective past control = 1; no past control = 0.

Risk of reinvasion. Control efforts can be negated if there is rapid and/or persistent reinvasion of controlled areas by the pest from surrounding habitat. Ranking involves a considered view of surrounding pest population densities, distances from the site to the nearest pest habitat and barriers to pest dispersal. Risk of reinvasion can be rated certain = 1, high = 2, medium = 3, low = 4, unlikely = 5 or impossible = 6 (Parkes 1990).

Control of other pests at the same site. Sites where this occurs should rank more highly if there are known interactions between pests (e.g. possum control may be followed by increased rat numbers and so possums and rats should be targeted) or if a single control operation targets more than one pest (e.g. possum baits also kill rodents and may result in secondary poisoning of mustelids, or if both rabbits and weeds susceptible to rabbit browsing are targeted). No pest interactions = 0; some pest interaction = 1; significant pest interaction = 2.

Other values at the site. Many of the esplanade and foreshore Reserves have amenity, cultural, public access and recreational values, as well as conservation value. Some of those other values are closely linked to pest management (e.g. wasp control in recreation reserves). Multiple values could be considered using a simple 1 = Yes, 0 = No score for each value, or if sites had been ranked for each value separately, those scores could be incorporated in the overall ranking for pest management.

Monitoring

Monitoring is taken here to mean measurement of the outcome of pest management both in terms of changes in pest populations (operational monitoring) and changes in the 'condition' of the values that were being threatened (outcome/performance monitoring). It is difficult to develop a practical monitoring method that provides sufficiently robust data from which defendable decisions can be made. The key is to ensure monitoring design is standardised, rigorous and, where practicable, follows statistical requirements of random allocation of sampling units (or at least ensures the distribution of transects are independent of the animals being surveyed) and appropriate stratification (Warburton & Cowan 2008). As for surveillance, the key to obtaining useful data is standardisation of method and training of staff (if necessary), use of the same method for repeated monitoring, and repeat monitoring done with same design, at the same time of day, season or year, etc. Choquenot and Warburton (1998) suggested 15–20% of the total operational budget should be allocated to monitoring.

Operational monitoring

Fraser (1998) reviewed monitoring methods for medium to large-sized wild mammals. Norbury et al. (2001) reviewed monitoring methods for small to large-sized mammal pests (see Appendix 7) and provided recommendations on frequency and design of monitoring. The recommended methods are usually applied on medium to large areas and so may need to be adapted for small reserves.

The simplest method of operational monitoring is change in ‘catch’ per unit effort. While this often refers to trapping (e.g. catch/100 trap nights) or hunting (e.g. kills/person-day) it can equally be applied to other indices such as non-toxic bait interference, or the proportion of tracking tunnels, wax tags or chew cards marked by the pest. The NPCA web site (www.npca.org.nz) provides downloadable protocols for use of traps and wax tags for possum monitoring. Forsyth (2005) details a protocol for estimating changes in the relative abundance of deer using a faecal pellet index. Goats and pigs may be monitored by a similar faecal pellet index, although frequency of pig sign (e.g. rooting) is often used as a monitoring method. Rabbits and hares are usually monitored by spotlighting or using an index based on sign and faecal pellets (McLean scale). Trapping has been the standard method for monitoring most small mammals (rodents, mustelids), usually with lines of 10–20 traps at fixed spacing, with distance dependant on species (see Norbury et al. 2001 for suggested spacings). Methods for and design of ant monitoring are described by Ward (2007a, b). Spurr (1995, 1996) provides details about the attractiveness of different baits for wasps.

For the esplanade and foreshore reserves, once pest occurrence and distribution has been determined, and sites prioritised for management, appropriate operational monitoring protocols can be developed based on methodologies noted above. This could be undertaken under a separate Envirolink grant.

Outcome/performance monitoring

Animal pests have a wide range of impacts on native ecosystems and their constituent organisms. The greatest impacts of animal pests in the esplanade and foreshore reserves are likely to be through predation of native animals and browsing damage to native vegetation.

Where predation of native animals is the key threat at a site, the native animal species most commonly used for monitoring the outcomes of pest management are native birds and native insects, particularly weta and beetles. Ure (2003) briefly reviews the main methods for monitoring native birds, namely five-minute counts and distance sampling. The main issue in relation to the use of these methods in small reserves is the small number of counting stations that can be fitted into such reserves, which results in low power to detect significant change and a longer time until change can be detected. This might be addressed by using slow walk transects (Ure 2003) if these were designed to provide maximal coverage of the reserve and so provide an approximate total count of birds in the reserve. Species lists might also be useful, on the assumption that in the absence of introduced avian predators a wider range of native birds might use a reserve. Numbers of weta and other invertebrates can be indexed using artificial refuges (weta ‘houses’, Spurr & Berben 2004). Watts (2004, 2007) describes methods for assessing benefits of rodent eradication for ground dwelling beetles. Some taxonomic expertise is required for beetle identification, but simple keys could be developed for NLCC use
(e.g. www.landcareresearch.co.nz/services/biosystematics/bioassist/index.asp).

Damage to native vegetation is likely to be mostly from foliage and seedling browsing, and consumption of fruits or seeds of native plants. Ure (2003) reviews the most commonly used methods for vegetation condition assessment at both reserve (e.g. satellite or aerial photos) and more detailed scales (photopoints, permanent plots, exclosures, foliar browse index). Choice of monitoring method should be dictated by a combination of the animal pests causing damage (e.g. possums impact on canopy, ungulates on lower vegetation tiers and seedlings, rodents on seedlings, seeds and invertebrates), the type of damage (e.g. leaf or seedling browsing) and the size of the reserve (several small plots may provide more representative information than a single large 20 x 20 or RECCE plot (Hurst & Allen 2007a, b) in a small or highly heterogeneous reserve. The impacts of wasps and invasive ants are mainly on native invertebrates so changes in numbers of key invertebrates could provide an appropriate method for outcome monitoring. For wasp impacts, stick insects or orb web spiders could be monitored, while for invasive ant impacts, particularly Argentine ants, changes in the occurrence and numbers of native ants might provide a suitable monitoring method.

As noted in Section 5.1, outcome monitoring also usually requires measurements before control is imposed and a matched site where there is no control so that the effects of pest management can be separated out from fluctuations in animal numbers in response to natural factors such as climate. This is important to ensure that any changes detected at the managed site can be attributed to the management action rather than from some natural (i.e. unmanaged) influences.

Plant Pests in the NLCC Esplanade and Foreshore Reserves

The TNRPMS has an extensive list of weeds. Ure's (2002) species list for the Nelson City Council Conservation reserves records 153 plant species as weedy. Ure's (2003) species list for the Waterworks Reserve (Matai and Roding) lists 33 plant species as weedy. The Esplanade and Foreshore Reserves Management Plan identifies weeds as a management issue at 31 out of the 43 reserves, with weed control of some kind being conducted at 19 of these (details not specified in the management plan). The four categories of weed management under the TNRPMS (total control, progressive control, containment, and boundary control) presumably dictate to varying extents the actions NLCC take for management of weeds in these categories in the esplanade and foreshore reserves since, for example, the goal of total control is eradication and that of containment is prevention of spread. Many of the issues relating to weed management, surveillance, and monitoring have been discussed in previous NLCC documents and reports (e.g. Myer 2007; Ure 2002, 2003).

Perusal of the various reports indicates that a small number of weeds are the predominant focus of NLCC weed management activity, namely buddleia, gorse, broom, old man's beard, banana passion fruit, wildling pines, Mexican daisy, barberry, Himalayan honeysuckle, and blackberry. Biological control agents are available for some of these weeds (gorse, broom, old man's beard, buddleia, blackberry), but it is not clear what part these agents play in NLCC's overall weed management strategy and whether any monitoring is associated with biological control agent releases.

Surveillance

It is generally accepted that finding and controlling new weeds early helps minimize future control costs and ecological impacts. New weeds may be either new to New Zealand or new to a particular region or site. Braithwaite (2000) provides an overview of DOC's weed surveillance plan. The key issues involved in weed surveillance are how best and how often to search for new weeds. How often to search was addressed by Harris et al. (2001), who adopted a precautionary approach of assuming that weeds will arrive at a site, and then determined by modeling what surveillance interval would be needed to find them (at different levels of probability) before they reached a specified threshold cost of control at the site. They concluded that surveillance intervals varied from 1–10 years depending on habitat type, weed growth form, weed visibility (which may vary seasonally), threshold cost of control and acceptable level of probability. The issue of how best to search has been addressed using search theory by Cacho et al. (2006). The most effective search system consists of parallel transects separated by the effective sweep width, which is in turn derived from a lateral range curve representing the probability of the searcher detecting the target as a function of its lateral distance from the searcher. Lateral range curves can be generated experimentally or an effective sweep width chosen based on expert knowledge, as was done by Brown et al. (2004) for weeds in New Zealand.

At present, surveillance for new weeds is done mainly in association with activity of staff at sites where existing weeds are being controlled. The effectiveness of this passive surveillance strategy depends on the skills and vigilance of staff involved, and carries a risk that new weeds may become established at sites where there is no control or in unvisited areas of larger sites. Myer (2007) advocated that any new weeds be controlled immediately they were found, and their location recorded by GPS so that follow up control could be efficiently carried out.

Prioritisation

New weeds

Williams and Newfield (2002) developed a system for ranking new weeds in order of priority for control. The system is based on questions about the history of the weed elsewhere, weediness of its taxonomic relatives, its potential interactions with native vegetation, the history of the weed in the area under consideration, and technical and social considerations in attempting control. The scoring system is weighted towards the most recently arrived weeds, on the assumption they will be easiest to control. The system was designed and calibrated originally for bird-dispersed climbers and woody weeds in the Nelson/Marlborough region. It has since been demonstrated to be adaptable to other plant life forms and vegetation types by trials in several DOC conservancies (Williams et al. 2005).

Existing weeds

There are many systems for ranking existing weeds (see references in Williams & Newfield 2002 and at www.weedscrc.org.au). Owen (1998) describes the Department of Conservation's systems for prioritising weed-led and site-led programmes. These provide a useful model for NLCC.

Weed-led programmes: Owen (1998) recommends that weed-led programmes, which focus on a species wherever it occurs, must first be assessed for feasibility and if all feasibility criteria are met then they should be conducted wherever possible. Prioritisation should be done by assessing (i) species weediness, and (ii) the practicality of control. Processes for conducting the feasibility assessment and the priortisation are provided in Owen's report and would be adaptable for use by NLCC. Timmins and Owen (2001) provide a good summary of DOC's prioritization process (Appendices 8, 9). Briefly, the following steps are used to rank proposed weed-led control programmes to select those that will give the best conservation return:

- Assess if the weed species meets the feasibility criteria for a weed-led control programme.
- Calculate the weed's Biological Success score (biological capacity).
- Calculate the weed's Effect on System score (impact).
- Calculate the Weediness Score and classify into a Weediness Group.
- Assess the Practicality of Control.
- Derive a Priority Ranking.

Weed-led programmes within DOC are restricted to those that can meet criteria for eradication or containment. If this reasoning was applied to the esplanade and foreshore Reserves then only those plants listed in the TNRPMS as eradication or containment weeds would be candidates for NLCC weed-led management programmes.

Site-led programmes: The system used by DOC is essentially the same as that described above for animal pest management. Firstly, sites are ranked for botanical and wildlife values using Shaw

(1988) and Elliott and Ogle (1985). Secondly, the suite of significant weeds that threaten the important conservation values at the site are identified, Thirdly, rank(s) are weighted by a score for urgency of control (see Appendix 10). Owen (1998) provides decision trees to guide the ranking and prioritisation processes, and these would be adaptable for use by NLCC.

Because sites often have multiple weeds, it is also necessary to prioritise weed species and order of control within sites. DOC does this by considering the relative 'weediness' of species, the practicality of controlling the species, and the potential of a weed species to create or exacerbate other weed problems. Weediness scores (WS) of individual species are calculated as WS = (2/EoS) + BSR), where EoS is the effect on systems score and BSR is the biological success rating in the DOC weeds database (Owen 1997; Appendices 11, 12). EoS is an assessment of the behaviour of a weed species in the community type and geographical location in NZ where it has the greatest impact on native species. BSR describes the biological capacity of the weed species (e.g. establishment and growth rates, seed number per plant, sexual/asexual reproduction).

Weed-led versus site-led programmes: The relative priorities for weed- versus site-led management are influenced partly by legislative responsibilities under the TNRPMS. Outside of that constraint, there is little guidance in the literature about criteria for relative prioritisation. Owen (1998) indicated that DOC assigns a higher priority to weed-led programmes than to site-led programmes; very high ranking site-led programmes rank equally with high to medium ranking weed-led programmes.

Many of the secondary sorting criteria reviewed above for animal pests would also be applicable to weeds, although their relative importance might be different. For example, the potential for weed replacement by other weeds is probably higher than for animal pests, and so the need for restoration activity associated with weed management is probably higher. Examples of this sort of reasoning are given in Williams (1997).

If insufficient information is available for individual pests, then Ure's (2002, 2003) Threats ranking provides an alternative approach.

Monitoring

Operational Monitoring

Ure (2002, 2003) reviewed briefly a number of approaches to weed monitoring in Nelson City Council Conservation Reserves. Myer (2007) made some recommendations about monitoring as part of the NLCC Waterworks Reserves Pest Plant Management Strategy. A comprehensive overview of weed monitoring rationale and methodology is given by Partridge et al. (2002) who developed an annotated flow chart to guide choice of monitoring methods and a set of monitoring modules that can be applied in the field. They adopted this approach, rather than a prescribed set of preferred approaches, because agencies making decisions about weed monitoring need to take into account a wide range of factors ranging from site-, local- and regional-specific issues to trade offs between statistically ideal approaches and resource availability. Techniques for monitoring the impacts of weed biocontrol agents are discussed at www.landcareresearch.co.nz/research/biocons/weeds/book/.

In some respects the nature of operational monitoring of weed management will be dictated by the classification of species under the TNRPMS. For boundary control pests and containment pests the main goal is prevention of spread, so monitoring of local and regional distribution will be important. For progressive control pests, prevention of spread is also important but so too are reductions in density and distribution. For total control pests the goal is eradication and so in addition to reductions in overall density and distribution, elimination from individual sites will be vital. These differing monitoring requirements are addressed by Partridge et al. (2002).

Outcome (performance monitoring)

The various types of threat posed by weeds to conservation values provide the context for outcome monitoring. Owen (1998) listed these as threats to (i) native plants from smothering, shading or other forms of competition and exclusion, (ii) native animals from habitat degradation affecting food supply, breeding sites, etc, and (iii) native communities from displacement of species, altered successional processes and changes to energy and nutrient flows. Outcomes of weed management are therefore likely to be reflected in changes in numbers and or distribution of threatened native plants and animals, and in measures of species occupancy, environmental representation and native dominance (Lee et al.2005) of native communities.

Ure (2003) and Myer (2007) recommended photopoints to monitor broad changes in vegetation cover. Changes in native animal numbers and/or distribution could be monitored using techniques described above, but the appropriate technique would depend to some extent on the particular species to be monitored. Changes in native plant numbers, condition and/or distribution could be monitored using the same techniques described for weeds by Partridge et al. (2002) and above for browsing animal pests.

Pest Management Data Recording and Management

Myer (2007) touched briefly on the issue of pest management data collection. Some data collection is required by legislation (e.g. pesticide use data under the Hazardous Substances & New Organisms Act 1996). With respect to the esplanade and foreshore reserves, there is a need to collect data on (i) current state of the reserves and their pest problems to provide a baseline for both reserve prioritization and future surveillance for new pests; (ii) operational activity in the reserves and associated monitoring on an annual basis; and (iii) outcome monitoring at a frequency determined by the methodology adopted and the expected rate of change.
Baseline data on the reserves should consist of:

- species lists for native and introduced plants and animals
- distribution maps of habitats/vegetation types and animal and weed infestations based on aerial or ground mapping and GPS locations
- stated operational and outcome goals for pest management for each reserve

Operational inputs (quantities and $ values) to pest management should be recorded for each reserve (recorded separately for each management unit within a reserve) including what control was done where and when, by whom, how control was undertaken, what it cost, what monitoring was done, and what the outcome of monitoring was. This requires details for each reserve of:

- identity, amount, timing, application rate, frequency of use, and cost of products for animal and weed management
- estimates of areas treated (preferably from GPS locations)
- staff time spent on pest management
- design, methodology and timing of monitoring, monitoring equipment and staff costs, and costs of analysis and reporting of monitoring data for each of operational monitoring and outcome (performance) monitoring.

The required information could be collected using a standard template either as a paper system or as input to a computer based system (using an appropriate database programme). Increasingly, PDAs and similar hand-held devices are used for data collection in the field. There may be advantage to NLCC in coordinating any system it used for recording of pest management information with systems used by Tasman and Marlborough District Councils. MAF Biosecurity NZ has recently begun a project on the development of a national pest management performance framework. This is likely to have implications for the type and format of information relating to pest management activities required from councils. In the short term NLCC may therefore wish to develop simple and flexible systems for its pest management data handling and reporting until the implications of any national system become clear. The design of such a system could be dealt with under an additional Envirolink grant.

Recommendations

The current lack of detailed information about native and introduced plants and animals in the esplanade and foreshore reserves limits the approaches available for initial prioritisation of reserves for management. NLCC should give a high priority to more detailed plant and animal surveys of the reserves.

Animal Pests

For initial prioritization of animal pest management for biodiversity protection and restoration until better information is available, NLCC should:

- treat Cable Bay Area Nelson Haven Area and Waimea Inlet Area separately in determining priorities.
- within each of these areas firstly, score reserves by
  - size (S) – less than1 ha =1; 1-5 ha = 2; 5-10 ha = 3; >10 ha = 4
  - predominant habitat form (PHF) - urban (mown area, border planning) = 1; narrow stream bank or coastal strips = 2; extensive stream bank or coastal strips = 3; sandflats, forest remnants, islands = 4
- multiply the (S + PHF) score by the Vulnerability to Threats score where, for each pest (or alternatively for all pests at a site),
  - no apparent risk of animal pest to any native biodiversity value = 1
  - no apparent risk of animal pest to a key native biodiversity value(s), but risk to other elements of native biodiversity value = 2
  - indirect risk of animal pest to a key native biodiversity value(s) = 3
  - direct risk of animal pest to native biodiversity values = 4
- add scores for the following secondary factors
  - past animal pest control at the reserve: effective control over whole area = 3; effective control over part of the area = 2; ineffective past control = 1; no past control = 0
  - other values at the site: for each major additional value - amenity, cultural, public access and recreational values – add 1 to score.

This provides a provisional method of ranking sites. In the longer term, NLCC should survey the esplanade and foreshore reserves for presence and distribution of native and introduced animals and undertake a detailed assessment of native vegetation to enable a more thorough prioritisation of sites and pest management. Once more detailed information is available, a more formal ranking of reserves for the conservation value of their vegetation and native animals should be undertaken as outlined in Appendices 2–4 and described above, and a wider set of secondary factors described above included in the scoring. At that time NLCC may need to adapt the advice presented in this report to take into account the place of the esplanade and foreshore reserve in any wider biodiversity action plans developed under the Nelson Biodiversity Strategy.

Operational monitoring of animal pests in the esplanade and foreshore reserves should be conducted using a standardised species-appropriate technique chosen from those listed in Appendix 7.

Outcome (performance) monitoring for browsing animals in the esplanade and foreshore reserves is probably best measured using photopoints, standardised seedling counts, and foliar browse index measurements. Outcome (performance) monitoring for predators is probably best measured using native bird species lists and transects in the larger reserves, and artificial refuges and pitfall trapping for invertebrates. Outcome monitoring may require measurement in areas not subject to pest management to act as controls for natural variation.

Surveillance for animal pests in the esplanade and foreshore reserves is best done using a standardised species-appropriate technique chosen from those listed in Appendix 5. Surveillance can often be undertaken as part of operational management and/or monitoring. NLCC should also consider targeted surveillance in the esplanade and foreshore reserves for high risk animal pests, such as Argentine ants.

Plant pests

For initial prioritisation of plant pest management for biodiversity protection and restoration until better information is available, NLCC should:

- decide on any weed-led programmes for weeds present in the esplanade and foreshore reserves. This should be done using the DOC process (Timmins & Owen 2001) to assess if the weed species meets the feasibility criteria for a weed-led control programme (see Appendices 8, 9). Species declared as pests in the TNRPMS should perhaps be considered as priority for weed-led management.
- use the method of Timmins and Owen (2001) to rank proposed weed-led control programmes to select those that will give the best conservation return.
- for site-led programmes in the esplanade and foreshore reserves, use scores from animal pest scoring steps 1 and 2
- multiply the (S + PHF) score by the Vulnerability to Threats score where, for each pest (or alternatively for all pests at a site),
  - no apparent risk of plant pests to any native biodiversity value = 1
  - no apparent risk of plant pests to a key native biodiversity value(s), but risk to other elements of native biodiversity value = 2
  - indirect risk of plant pests pest to a key native biodiversity value(s) = 3
  - direct risk of plant pests to native biodiversity values = 4
- add scores for the following secondary factors
  - past plant pest control at the reserve: effective control over whole area = 3; effective control over part of the area = 2; ineffective past control = 1; no past control = 0
  - other values at the site: for each major additional value - amenity, cultural, public access and recreational values – add 1 to score
  - potential of site for restoration: significant benefit to native vegetation at site likely to be achieved in 1 = >15 years; 2 = 5-15 years; 3 = 1-5 years; 4 = <1 year.

This provides a provisional method for ranking sites. For prioritising weeds within sites for management, NLCC should use the weediness scoring system developed by DOC (Owen 1997; Appendices 11, 12).

In the longer term, NLCC should survey the esplanade and foreshore reserves for the presence and distribution of plant pests to enable a more thorough prioritisation of sites and plant pest management. Once more detailed information is available, a more formal site-led prioritization should be undertaken. At that time NLCC may need to adapt the advice presented inn this report to take into account the place of the esplanade and foreshore reserve in any wider biodiversity action plans developed under the Nelson Biodiversity Strategy.

Operational monitoring of plant pests in the esplanade and foreshore reserves should use the annotated flow chart of Partridge et al. (2002) to guide choice of monitoring methods and the appropriate field monitoring modules.

Outcome (performance) monitoring should be done using photopoints to monitor broad changes in vegetation cover. Changes in native plant numbers, condition and/or distribution should be monitored using the same techniques described for weeds by Partridge et al. (2002). Changes in native animal numbers should be monitored using the same techniques described for animal pests. Outcome monitoring may require measurement in areas not subject to pest management to act as controls for natural variation.

Surveillance for plant pests in the esplanade and foreshore reserves is best done initially using the current system of detection during management. However, not all reserves, and not all parts of the larger reserves are likely to receive weed control, and a number of the reserves are at high risk from garden escapes. To minimize the risk of new weeds establishing at such sites, surveys of them should be repeated two yearly. Any new weeds found can be ranked in order of priority for control using the system developed by Williams and Newfield (2002).

System development

To assist NLCC with further development of issues relating to its pest management activities in the esplanade and foreshore reserves, NLCC should consider future Envirolink grant applications for:

- advice on design of appropriate operational and outcome (performance) monitoring protocols
- advice on design of appropriate surveillance protocols for animal and plant pests.

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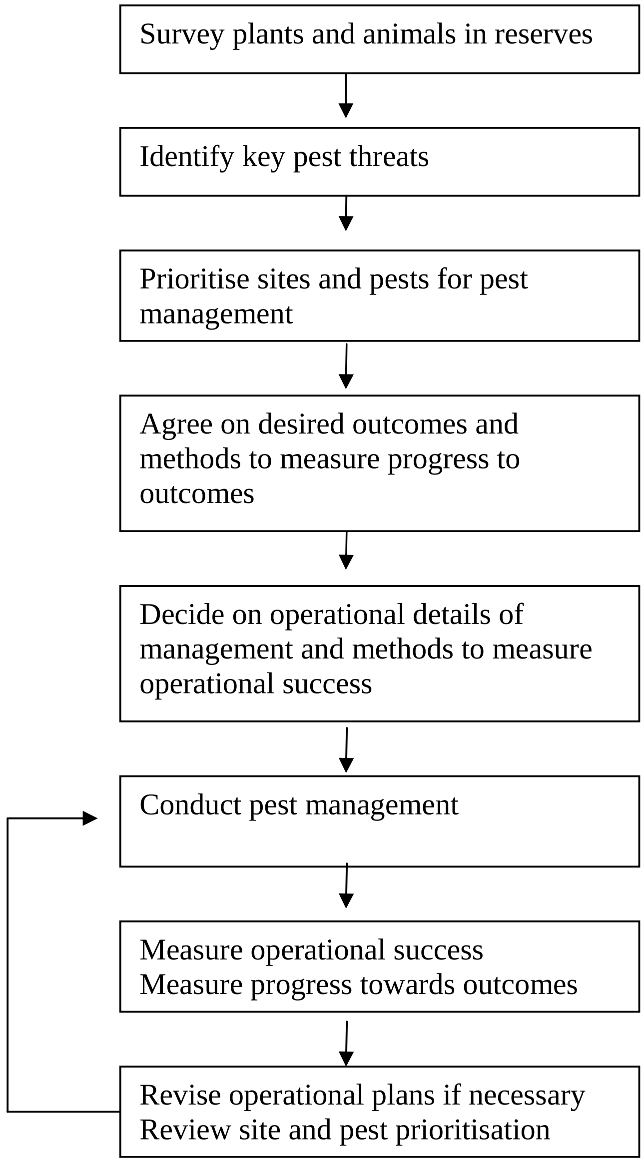
Appendix 2. Proposed process for NLCC pest management planning



Appendix 3. Criteria for ranking by conservation value of animals (after Elliott & Ogle 1985)

A management unit is ranked on a scale with a high of 6 to a low of 1, depending on its value as habitat for native animals.

Score 6: Nationally Important
- Contains animal species endemic to the unit or Ecological District, or the animal is better represented in the Ecological District than in any other district in the country.

Score 5: Of Outstanding Value
- A highly endangered, rare, or restricted endemic species breeds in the unit.
- The management unit is essential to highly endangered, rare or restricted species for purposes other than breeding.
- The management unit is of vital importance to internationally uncommon species (breeding and/or migratory).
- The management unit is of vital importance to internally migratory species with very limited distribution or abundance.
- Largely unmodified ecosystems or examples of original habitat not represented elsewhere; of large size and containing viable populations of all or most species typical of such ecosystems.

Score 4: Highly Valuable
- Site containing a native species which has declined significantly as a result of human influence.
- One of a few, or the only breeding area, for a non-endemic native species of limited abundance.
- Habitat of an uncommon, discontinuously distributed species not adequately represented in a particular Ecological Region.
- Example of a largely unmodified site which is not represented to the same extent elsewhere in the Ecological District and is used by most species which are typical of that habitat in that Ecological District.
- Supports a species of an endemic family which is of limited abundance nationally although adequately represented in one Ecological District but whose habitat is at risk.

Score 3: Moderately to Highly Valuable
- The management unit supports a species still widely distributed but whose habitat has been reduced.
- A management unit with large numbers of breeding or moulting birds or where breeding or moulting areas are of inter-regional significance.
- Large and fairly unmodified site which is represented elsewhere in the Ecological District and contains all or most species typical of that habitat for that Ecological District.
- A management unit where any species is exceptionally abundant or whose behaviour is exceptional but which is otherwise widespread.

Score 2: Moderate Value
- All sites supporting good numbers of species which are typical of that habitat within an Ecological District and which have not been heavily modified by man.

Score 1: Potential Value

- Areas whose value to native animals is limited by small size, heavy modification, or other factors, but could be more value to animals if left to regenerate, or managed and developed for their benefit.

Appendix 4. Criteria for ranking by conservation value of vegetation (after Shaw 1988)

Units are ranked for conservation value of vegetation, with low = 1 and high = 6.

Score 6: Of National Importance
- Contains a nationally endemic plant species or plant community; or
- The endemic plant or plant community is better represented in the Ecological District than any other district in the country.

Score 5: Exceptionally Valuable
- Containing plant communities of great scientific value, for example, nationally rare successional sequences or mosaics, or containing no introduced plants (where this is rare in the plant community concerned).
- Site where a plant community, or more than one species of plant, reaches a geographic limit.
- Contains good examples of nationally rare plant communities vegetation types.
- Contains rare and endangered species which are not endemic to the Ecological District, but are at risk nationally.
- Large areas defined as representing, either entirely or significantly, the natural character of the Ecological District.

Score 4: Very Highly Valuable
- The last, or one of a few remaining examples of a plant community which was once more widespread in the Ecological District. The example must still retain most of its natural character.
- Containing regionally rare plant communities in good condition and forming part of a larger tract of vegetation, for example, subalpine and alpine areas surrounded by a large tract of forest.
- An example of the vegetation of an Ecological District that forms a continuous ecological or altitudinal sequence across a District and not better represented elsewhere in the Ecological District.
- The last, or one of the few remaining examples of a secondary succession that has developed following disturbance to the vegetation in pre-European or early European times.
- Good quality examples, or the only example of a secondary succession that has developed following a large disturbance such as mass ground movement, storm damage or fire.
- Nationally rare plant communities which have been degraded in value, for example, containing problem weeds.
- Large (over 300 ha) examples of secondary vegetation where there is relatively little (e.g., less than 5%) of an Ecological District remaining in native vegetation.

Score 3: Highly Valuable
- Good quality moderately large (300–1000 ha) examples of native vegetation typical of an Ecological District where there are other better quality large (over 1000ha) examples.
- The last, or one of the few remaining areas of plant community within an Ecological District in a modified condition, but retaining the main elements of composition and structure.
- An example of the vegetation of an Ecological District that now forms part of a culturally interrupted ecological and/or altitudinal sequence.
- Sites where individual species attain limits of geographical distribution.
- Regionally rare, intact, or relatively unmodified plant communities completely or largely surrounded by a highly modified landscape, for example, small urban reserves.

- Areas of unmodified or secondary vegetation which provide a buffer around exceptional or nationally important sites.
- Areas containing rare and endangered species which occur over a wide area of New Zealand and are not at immediate risk of extinction.
- Areas of an early secondary botanical succession developed after major or repeated disturbance by man where the present vegetation (e.g., bracken fernland or manuka scrub) is vastly different from the vegetation type which would (or could) develop over a long period (e.g., tall forest), or where there are very few or very small remaining other examples of the natural vegetation of the Ecological District; that is, this secondary type is now representative of the Ecological District.
- Areas with widespread but rare or endangered species but which also contain a significant, transitory foreign element.
- Sites where species or vegetation types attain or are very close to a local limit of geographic distribution.

Score 2: Moderately Valuable

- Substantially modified plant communities retaining their main elements of composition and structure.
- Modified areas (selectively logged, lightly burnt) better represented at other sites in the Ecological District.
- Intact or relatively unmodified areas that are better represented elsewhere in the same Ecological District.
- Parts or much larger areas as buffers around sites of higher rank.

Score 1: Of Potential Value

- Mosaic(s) of native and foreign vegetation where the former are small and of no particular interest.
- Small areas of foreign vegetation surrounded by large areas of native vegetation.
- Areas similar to Score 3(h) where better examples grow in the Ecological District.
- Areas similar to Score 3(h) where the vegetation is dominated by adventive foreign plants.
- Man-made areas of recent origin, with native vegetation.

Appendix 5. Surveillance/detection methods

Species	Methods	General Comments
Possums	Spotlighting Faecal pellets Wax tags/chew-track cards Traps (leghold, kill or cage)	Faecal pellets may be hard to find in thick vegetation, and a key may be needed to assign to likely species. Wax tags and chew cards are cheap and simple to use but require training or a key to discriminate species Tracking tunnels are good for rodents and stoats and possibly ferrets. Training or a key may be needed to discriminate species Trapping may not be possible in some reserves. It is effective for rodents, mustelids and possums. Public reporting of pests in reserves should be encouraged. Vespula wasps and ants can be attracted to traps using a mix of sugar and protein baits. Keys to species are available at www.landcareresearch.co.nz
Rodents	Tracking tunnels Traps Faecal pellets Wax tags/chew-track cards	
Mustelids	Traps Tracking tunnels Faecal pellets	
Hedgehogs	Spotlighting Road kill Faecal pellets	
Lagomorphs	Field sign (e.g. scrapes, burrows) Faecal pellets	
Feral cats	Sightings, public reports Faecal pellets Spotlighting	
Pigs, goats, deer	Sightings, public reports Faecal pellets	
Non-native birds	Sightings 5-min bird counts	
Wasps	Sightings Baited traps	
Ants	Visual searching & collection Baited traps	

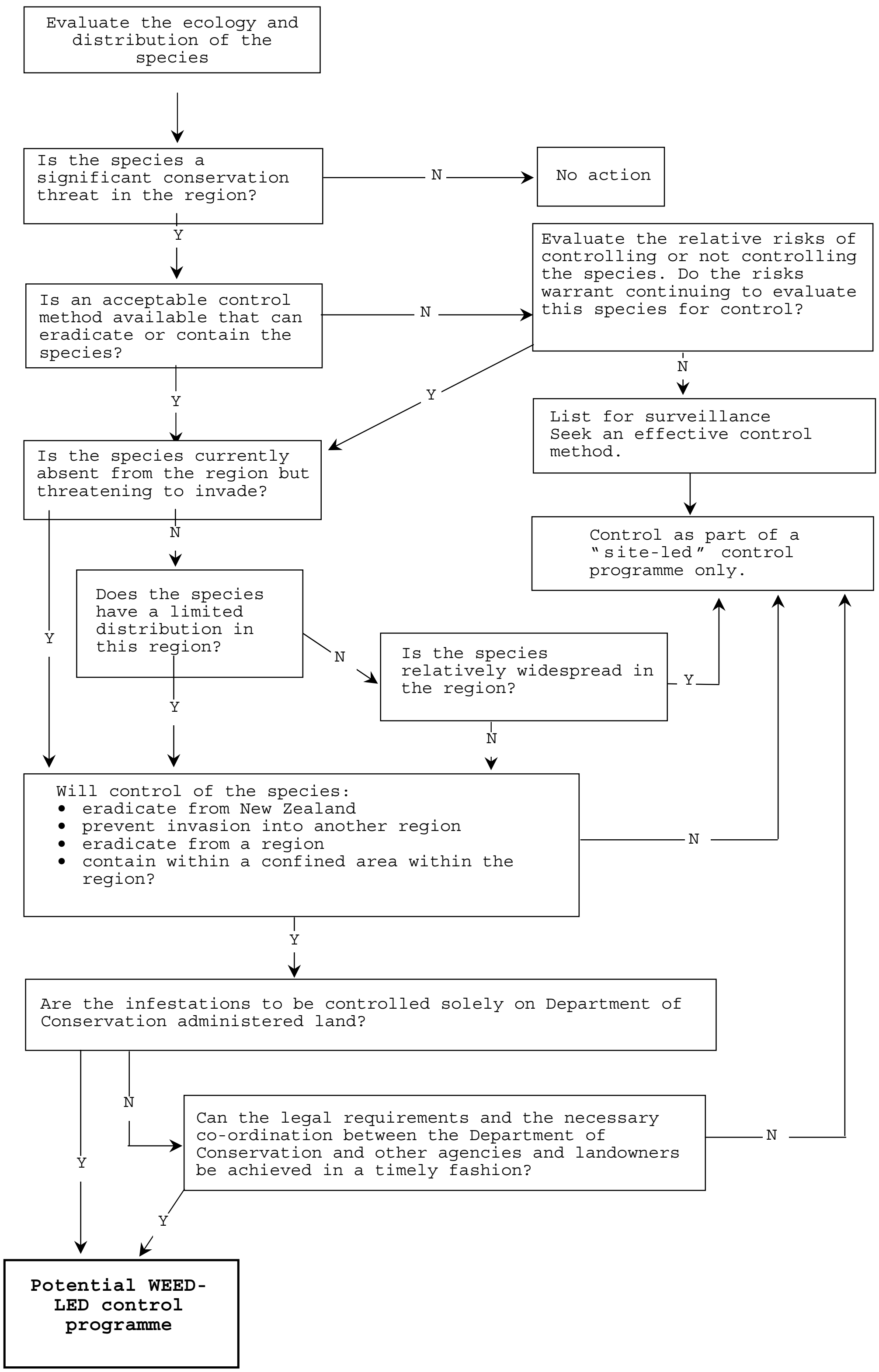
Appendix 6. Ure (2002, 2003) evaluation criteria for reserve ranking

Criterion	Scoring
Rarity	Number of plant species listed on NZ Botanical Society threatened plant list, or number of rare or endangered native animals
Representativeness	0 = virtually no indigenous vegetation 1 = highly modified or damaged 2 = moderately intact 3 = one of the better sites known 4 = outstanding
Size	1 = very small: too small to maintain or develop full vegetative character without support from adjoining natural areas 2 = small: can maintain or develop full vegetative character over at least 50% of reserve without support from adjoining natural areas 3 = medium: can support several breeding territories for medium sized native birds or provide useful habitat for waders 4 = large: can support viable populations of tui and bellbirds or provide significant habitat for waders
Connectivity	1 = very isolated 2 = discrete but some linkage to other natural areas 3 = part of semi-continuous natural landscape 4 = part of continuous natural landscape
Potential for restoration	1 = >15 year 2 = 5-15 years 3 = 1-5 years 4 = <1 year

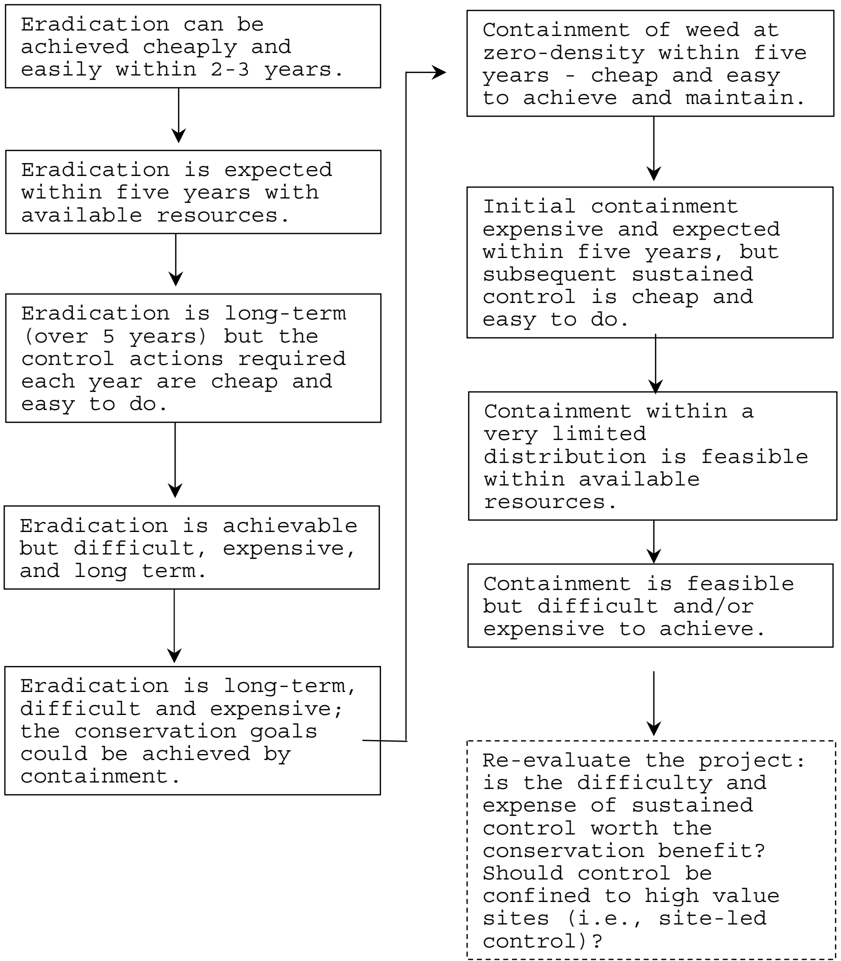
Appendix 7. Recommended monitoring methods for mammal pests (Norbury et al. 2001)

Species	Monitoring Methods
Deer	a) Presence/absence of faecal pellets b) Total counts of pellet groups
Feral goat	a) Presence/absence of faecal pellets b) Total counts of pellet groups
Feral pig	Presence/absence of pig sign
Possum	a) Presence/absence of faecal pellets b) Trap catch c) Wax tags
Rabbit	a) Total counts of rabbit sign b) Modified McLean scale
Hare	a) Presence/absence of faecal pellets b) Pellet recruitment
Ferret	Trap-catch
Stoat	Trap-catch
Weasel	Trap-catch
Feral cat	Trap-catch
Hedgehog	Trap-catch
Ship & Norway rat	Trap-catch
Mouse	Trap-catch

Appendix 8. Flowchart for determination of weed-led programmes (Timmins & Owen 2001)



Appendix 9. Flowchart to assess practicality of control of a weed at a particular location (Timmins and Owen 2001)



Appendix 10. Criteria for assessing urgency of weed control (from Owen 1998)

Score	Criterion
3.5	Site has plant community or plant or animal species known or very likely to be at risk of national extinction
3	Site has plant community or plant or animal species known or very likely to be at risk of local extinction
2.5	Conservation values that contributed to the biodiversity score for the site at risk from major damage in near future but at present weeds are having no or little impacts on those values
2	Significant changes to the important conservation values that contributed to the biodiversity score for the site are know or are very likely to have already occurred due to weeds , and further damage is expected
1.5	The current suite of weeds at the site are unlikely to affect the important conservation values that contributed to the biodiversity score for the site but are affecting, or are likely to affect, other important values at the site
1	The important conservation values that contributed to the biodiversity score for the site are likely to remain intact with the current suite of weeds at the site

Appendix 11. Criteria used to score the Biological Success (BS) of a weed species (Timmins & Owen 2001)

Biological Attribute	Criteria and Scores			
	0	1	2	3
Maturation rate		Sets seed only after 3 or more years; or has very slow vegetative growth.	Sets seed within 2–3 years; or has moderate vegetative growth.	Sets seed within first year; or has very rapid vegetative growth.
Seed set	No seed set.	Low seed set.	100–1000 seeds set per plant.	More than 1000 seeds set per plant.
Persistence of seedbank	No seed set.	Seed is viable for less than 1 year.	Seed has an estimated viability of 1–5 years.	Seed viability estimated at over 5 years.
Effectiveness of dispersal	Not spread.	Propagules spread by gravity or human activity.	Propagules spread by wind or water.	Very light, wind-dispersed seeds or propagules spread by birds or feral animals.
Establishment and growth rate		Poor establishment and slow growth.	Poor establishment and fast growth; or good establishment, slow growth.	Good establishment and fast growth.
Vegetative reproduction	No asexual spread.	Minor importance.	Moderate importance; plants spread by stem layering or suckering.	Plant spread freely by stolons, rhizomes, bulbils or other asexual means.

Appendix 12. Criteria used to score the Effect on System (EOS) of a weed species (Timmins & Owen 2001)

Impact on native communities	Criteria and Scores			
	0	1	2	3
Composition and structure of terrestrial native communities	Does not affect structurally dominant species.	Minor change in composition of dominant species; little change to basic structure.	Modest effect on composition or structure of community.	Major change to composition or structure of community.
Suppression of regeneration of native species	No significant effect.	Some effect on some species.	Major effect on some species or some effect on dominant species.	Major effect on many species; or major effect on dominant species.
Persistence of the weed species over time	Does not persist.	The weed species' lifespan is less than 5 years.	The weed species' lifespan is 5–50 years.	The weed species' lifespan is over 50 years; or forms self-sustaining monoculture.