

**Guidelines for Determining and Naming Categories of Plants in
Regional Pest Management Strategies**

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Summary

Project and Client

A discussion document that proposes a logical framework for dealing with categories of pest plants was prepared for Environment Southland by Landcare Research during September 2006 to February 2007.

Objectives

To review the existing terminology used for plants in regional pest management strategies (RPMS). To propose for discussion a logical framework for determining and naming pest plant categories that all councils could use when writing a RPMS.

Methods

The terms and rules used in many of the current or proposed RPMSs as at 16 September 2006 were summarised. From the wide variation in terminology I have tried to conserve the good points about the 'old' terms and concepts, and at the same time pick up what is good about the 'new' terms and concepts, all the time mindful of the need for flexibility within councils.

Main Findings

The present framework for defining pest plants is unsatisfactory and this has meant that many councils have invented their own systems. The result is that there is little co-ordination in the use and meaning of terms between councils. In total, the categories used to define plant pests have the following main components; the extent of the plant population, where it is to be controlled, who is responsible for controlling it, and the rules applicable to the pest plant. Examples are given.

Conclusions

A logical framework for determining and naming pest plant categories that could be applied by all councils was constructed, based on the concepts found in the existing wide range of terms. This should be seen as a "tool box" that councils can draw upon for the appropriate terms when categorising plants in regional pest management strategy (RPMS). The system is consistent with the present understanding of the process of plant invasions and the strategies needed to deal with them. It is consistent with the Biosecurity Act (1993), and other legislation the councils operate under, and should be comprehensible to those administering the RPMS, and to the public.

Recommendations

The system proposed ought to be widely discussed by Councils and other interested parties, and used as a starting proposal for a new nationally accepted pest plant classification system.

1. Introduction

A discussion document that proposes a logical framework for dealing with categories of pest plants was prepared for Environment Southland by Landcare Research during September 2006 to February 2007. The framework is intended to be appropriate for use by all councils within New Zealand responsible for preparing regional pest management strategies.

2. Background

Pursuant to the Biosecurity Act 1993 (hereafter the *Act*), regional councils are the agencies responsible for processing and approving a regional pest management strategy (RPMS). Although councils are under no statutory obligation to undertake pest management actions, in practice, most regional councils process and make their own RPMS, and then manage it themselves.

The *Act* states several conditions that must be met for an RPMS proposal to be acceptable. These include demonstrating that the benefits of having a strategy outweigh the costs of co-ordinated action through the strategy. These same conditions apply to all individual organisms proposed in the strategy. This account considers only plants. Where a strategy requires persons to meet the costs of the strategy, these persons must either receive the benefit or, alternatively, be the exacerbators of the problems proposed to be resolved by the strategy. For an organism to be included as a 'pest plant' in a strategy it must be capable of causing at some time a serious and unintended effect within the region on one or more of the following: economic well-being, indigenous biodiversity in the broadest sense, soil and water processes, human health and enjoyment of the environment, and the relationship of Maori and their cultural traditions with the natural environment, and their other traditions.

As a consequence of these requirements, councils must follow a well-considered and rational process in proposing, implementing and managing an RPMS. At this point in time, February 2007, all regional councils have an RPMS in place and many are in the process of reviewing them. To aid this process a group from the regional councils known as the Biosecurity Generic Guidelines Group (BGGG) prepared its *Guide to Reviewing Regional Pest Management Strategies* (Anon. 2005) (hereafter, the Guidelines). This guide was aimed not only at assisting councils to comply with their statutory obligations when preparing a strategy, but also to achieve some national uniformity of definitions and explanation of pest categories across councils.

To aid councils in the use of terms, the Guidelines recommended the use of three pest categories and considered these could apply to all classes of organisms. These are 'total control pests', 'containment pests', and 'regional surveillance pests'. The Guidelines also advocate the use of the 'infestation curve model', which is a stylised representation of the spread of a plant (Appendix 1), to assist in the appropriate classification of the plant as a pest plant.

The Guidelines make some effort to relate the pest categories to the conceptualised stage of the pest on the infestation curve, e.g. 'a regional surveillance pest is more likely to be in the

central portion of the curve'. The Guidelines also go so far as to suggest who should be responsible for controlling pest plants at different stages on the curve. For example, regional surveillance pest plants 'would generally be undertaken by the council and *not the land occupier* (authors italics)' and appendix IV of the Guidelines, examples of strategy rules, states that for total control pests the '*occupier shall be responsible*' for controlling pests.

Despite the efforts of the BGGG, the terms used in the current and proposed RPMSs vary widely between councils. An examination of many current or draft RPMSs (16 Sep 2006) (note: I purposely do not identify individual councils in this report) revealed at least 20 unique pest plant categories. The terms used by RPMSs are usually explained and with their own internal logic within an individual RPMS, but the same words apply to quite different 'infestation stages' and sets of rules across councils.

One of the reasons so many councils have prepared and manage their own RPMS is that the *Act* is permissive rather than proscriptive, with few defined classes of organisms. Thus it is hardly surprising that a wide array of pest categories have been used. This would not matter if terms were used consistently for the same class of pest; if, for example, total control pest plants applied to those species of the lowest abundance to be controlled everywhere, and anywhere, within the region by the councils. In some RPMSs or current reviews this is exactly how the term is used. In another, it refers to widespread plants that are to be controlled by the occupier.

The BGGG was aware of the inherent difficulties in defining and explaining pest categories and suggested, 'given the current range of complexity and diversity in current RPMSs this (hierarchy of pest status) may have to be the subject of a separate project.'

The primary reason for this divergence and diversity of terminology is that since the *Act* came into being, the demands made of RPMSs have increased from controlling a limited number of primarily agricultural pests, to a large number of pests with impacts, or potential impacts, on biodiversity and other values. Because most of these species originate from urban areas, classes of pests and the rules applied to control them have expanded to cover a much wider range of land uses and classes of land ownership. The wide variation in the size of the councils undertaking RPMSs means that some have very large budgets for preparing and managing RPMSs, while others have very limited funds.

The diversity of problems and resource levels across all councils means that it is impossible to have a single set of three categories that can be applied with the same meaning in all regions as outlined by the BGGG.

3. Objectives

To propose a logical framework for determining and naming pest plant categories that could be applied by all councils, that is

- a 'tool box' that councils can draw upon, individually or in total, when writing RPMS
- consistent with the present understanding of the process of plant invasions and the strategies needed to deal with them

- consistent with the *Act*, and other legislation the councils operate under
- comprehensible to those administering the RPMS and to the public.

There is such a very wide variation in terminology in use by councils that I have tried to conserve the good points about the ‘old’ terms and concepts, and at the same time pick up what is good about the ‘new’ terms and concepts, all the time mindful of the need for flexibility within councils. It is stressed that this is a discussion document.

4. Components of Pest Category Names

From an examination of the terms and rules used in many of the current or proposed RPMS, there appear to be at least six components used in constructing and implying meaning to RPMS categories, programmes components and placing of individual *weeds*. (Terms in italics are in Appendix 2, and *weeds* is used as a general term to cover plant species that may or may not be categorised as *pest plants*.) These components are:

1. Whether or not the weed is classified as a *pest* under the *Act* – although it may seem counter-intuitive to have organisms listed in RPMSs that are neither pests nor *unwanted organisms*, as at least one RPMS does. The reasons for this are explained below (5.1.1).
2. The *current* and *potential* distribution and abundance of the pest plant. At a *regional* scale the *current* distribution is fairly straightforward, even if poorly known, and is often defined on maps in the strategy. The *potential* distribution is limited by knowledge of the species’ ecology and predictive tools. The proportion of the *potential distribution* can be compared with the *current distribution*, e.g. currently only 10% of potential range.
3. The impacts the pest plant is having and what values are being protected by controlling it. There has been an increasing tendency to use terms such as ‘biodiversity pest programmes’, meaning species that are controlled specifically to reduce their impacts on ‘biodiversity values’. These programmes are often undertaken in close association with the Department of Conservation (DOC).
4. The level of reduction in the pest plant population that is expected within the terms of the strategy (or other defined period). This may be expressed directly, i.e. ‘eradication pest plants’ where the implied aim is to eradicate the species, or alternatively, by the level of pressure on the population, i.e. ‘*total control* pest plants’. On the other hand, ‘*surveillance* pest plants’ implies that the species will be only under close observation – the Concise Oxford definition of the word.
5. Where the pest plant is to be controlled. This is sometimes implied as an important component of the category by the term ‘*site-led*’. *Boundary control* also has connotations that the pest will be controlled in particular places.
6. Those responsible for controlling the pest plant. Examples include the term ‘*boundary control* pests’, which implies a property occupier will control the pest, while

‘community initiative programmes’ implies the ‘community’ will be controlling the pests.

Current distribution can be verified, at least to the limits of the resources allocated to do so. There should be no confusion, then, if pests were categorised simply by their current distribution. All data from all councils would then be directly comparable.

The remaining components are concerned mostly with the risks posed by the pests and the feasibility of co-ordinated control through RPMS, and the presence or absence of rules or other legal restrictions indicating responsibilities for control. There is a large ‘political’ element involved in these components of the terms. Because councils imply political imperatives in the category names they construct and use, and because the imperatives differ from region to region, the category names of identical or similar assemblages of words mean different things in different regions.

Each of these components will be discussed in Section 5.1, in the order above, and then consideration is given as to how they might be brought together into a framework. [Whether a plant should or should not be in individual RPMS at all is considered briefly in Appendix 3.]

5. Framework for Defining and Naming the Pest Plant Categories in RPMS

‘Weed risk assessment’ and the feasibility of *co-ordinated control* are vital issues determining whether to include a weed in a RPMS at all. These issues are dealt with in detail by the *National Post-Border Weed Risk Management Protocol* (Anon. 2006), published by Standards Australia and Standards New Zealand. This important document appeared after the current round of RPMS reviews but it has much to offer those preparing RPMSs in New Zealand. Rather than repeat much of that material, emphasis is placed here on detailing the components that would be used to categorise a weed, including its legislative status, once it has been decided to include it in an RPMS.

It is often the intent of those preparing RPMS to convey the full implications of the RPMS category in one or two words. However, it is not possible for councils to combine all the components they use in naming categories (1–6 in Section 4) in two or three words and still achieve unanimity of meaning among councils. In theory, different names could be given to categories with the same meaning, provided that it was presented along with all applicable components and rules etc., and these components were presented in the same logical order for each pest plant category, and for each *pest plant*. Regardless of the actual word(s) used to name the category, all categories would be directly comparable across all councils. It is still preferable, especially for the public, for councils to name their categories of pests the same, where these categories have the same implications.

5.1 Framework components

5.1.1 Pests and potential pests

Councils are entitled to spend money to analyse and evaluate the risks posed by potentially long lists of plants known to be either outside their region, present in the region only in

cultivation, or growing in the wild. However, they cannot impose costs, even if these are only opportunity costs of growing a plant, without justification. They may therefore wish to indicate that certain plants may have legislative requirements attached to them in the future that may involve opportunity costs. Councils may therefore wish to indicate two classes of plants in their RPMS: ‘pests’ under the *Act*, and plant species that might have potential to be legislated as pests. This division then, between those weeds in the RPMS as *pests* or *unwanted organisms* and those that are not, but which it still wishes to be able to investigate, is the first component of the framework.

What should a list of plants that are neither *pests* nor *unwanted organisms* under the *Act* but which are included in the strategy be called? As far as I am aware, only one region has such a list in their RPMS and they are termed ‘research plants’. While at first this seems an appropriate word, ‘research’ on plants in the region is something that is undertaken on a much wider range of categories including many pest plants and other weeds. For example, councils make contributions of money and in kind to biocontrol research on pests. As a species is presumably required to have at least potentially significant effects to be in the strategy at all, the term *potential pests* seems more appropriate and evocative of the intent of the strategy. Thus each strategy which had such category would have *potential pests* and *pests*, with the former having no legislative restrictions or rules attached and the latter having legislative restrictions and rules.

Note that plant species on the National Pest Plant Accord (NPPA) list are *unwanted organisms* and while some councils include them in their strategy as Pests, others do not, although the legislative requirements applying to them are sometimes essentially the same as those applying to a category within the same strategy, i.e. only banned from sale etc.

Both Potential Pest Plants and pest plants may be at any stage of invasion (see 5.1.2 and Appendix 1)

Note that several councils have plants they are unsure about and which they are studying more closely before applying more stringent rules (‘risk assessment plants’, ‘surveillance plants’), but these nevertheless all have rules attached (e.g. banned from sale) and are therefore *pest plants*. These are not necessarily *unwanted organisms*.

5.1.2 Invasion stage

A critical component of whether or not to classify a plant as a pest is its *current distribution* in comparison with its perceived *potential distribution*. This is because everything else aside, the spatial spread of a plant combined with the number of individuals and their mass is the principal indicator of impact.

In the absence of detailed analysis using programs such as climate matching, councils have commonly used the ‘infestation curve’ as a way of portraying their current understanding of the invasion stage of a weed. The logic behind this visual model was explained to a New Zealand audience in Williams (1997) where it was referred to as ‘invasion’ stages. I still believe the term ‘invasion curve’ is more appropriate than ‘infestation curve’ in RPMS, because it is less pejorative and can be applied to all weeds, including pest plants and *potential pest plants*. The word “infestation(s)” can be used when referring to particular patches or areas of weeds. The essential argument of this model is that plant invasion is a staged process along a more or less sigmoid-shaped curve (Appendix 1). Incidentally, Google

Scholar returns zero hits for ‘plant population growth phase’ and three hits for ‘plant population growth stage’, so ‘stage’ it is.

Two interesting facets of this model in the New Zealand literature and its appearance in RPMS is the variation in the number of ‘stages’ indicated along the curve, and the attempt to define the invasion stages by the number of sites the species occupies.

For practical purposes the curve should be presented with the minimum number of divisions needed to portray both the verifiable stages (e.g. presence: absence within the *region*), and those that can be usefully applied to classifying weeds in RPMS.

For weeds that it is considered desirable to keep out of the region, Stage 1 must be when the weed is still outside the border of the region.

Once inside the region the weed must first form founding populations in the wild in order to invade. Many species do occur in the wild, often repeatedly, but then fail to form self-sustaining populations some distance from the founders. In other words they fail to fully naturalise. These founding populations are Stage 2 or teetering on entering Stage 3.

Most successful eradication programmes at a regional scale have been conducted on plants at Stage 2, i.e. when they are barely established. It is for this reason that Stage 2 needs to be recognised as a critical stage where the species is genuinely vulnerable to eradication at a regional scale. Many successful eradication programmes of this kind have occurred without the plant species even appearing in the RPMS of the region. For example, once it was apparent that *Senecio glastifolius* (holly-leaved senecio) was spreading rapidly in the North Island, the only known patch in the northern South Island was controlled to the point where we can say it has been eradicated.

Once secondary populations have begun to form, i.e. the plant has fully naturalised, the only other strictly logical point on the curve is when the species has totally occupied its range. This, however, is seldom achieved and probably has not yet occurred for any naturalised species in New Zealand. However, a point on the curve that has drawn the attention of weed scientists and control agencies is that point where the *rate* of spread appears to increase dramatically. This has been clearly demonstrated for a hawthorn (*Crataegus* sp.) population in Canterbury (Fig. 1). Looking backwards in time then, the period between full naturalisation and the point where a species begins to spread more rapidly can be seen as Stage 3. Stage 1 and Stage 2 in combination, up to the beginning of Stage 3, often take decades (say, >50 years), and they are referred to as the ‘lag phase’.

If there are species within a region that are of such high risk that eradication is desirable, yet they do not conform to the strict criteria of being practical to eradicate, then that RPMS should not use this category (see 5.1.4).

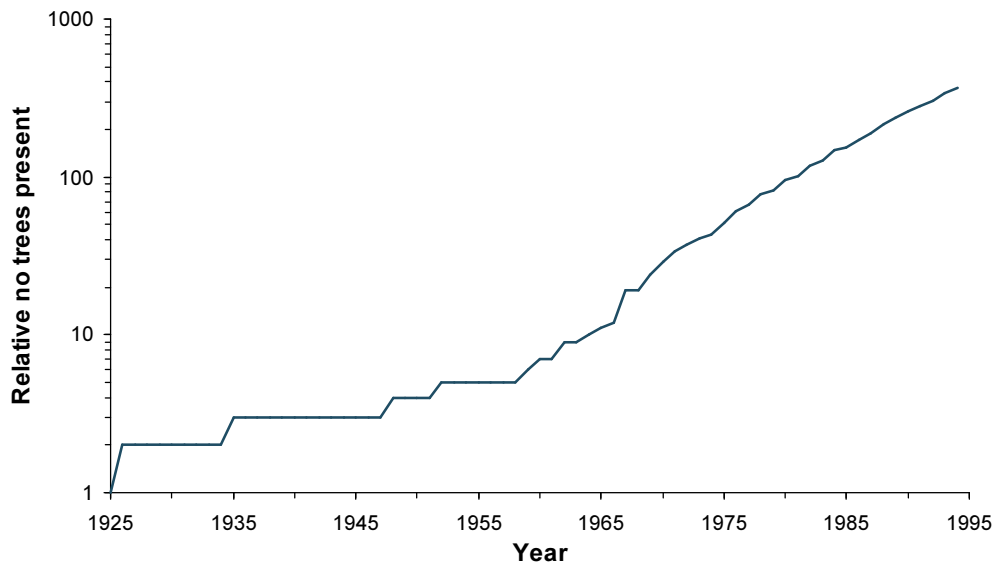


Fig. 1 Relative number of hawthorn trees at Porters Pass through time. Note that the vertical scale is a log scale. The population began to expand rapidly in about 1960 (P. Williams, J. Kean, R. Buxton, S. Ferris, unpublished data).

From Stage 3 onwards along the invasion curve, things become a little murkier. However, if we imagine that from Stage 3 the species continues to increase rapidly until it appears to grow in a large proportion of available habitat, but has yet to cover much of its potential range, then we can admit to a 4th stage. Beyond here we have the 5th stage where the plant is found virtually anywhere it is capable of growing. The total extent is limited by land use and localised control efforts and is likely to fluctuate.

To my mind, any further subdivision of the invasion curve would serve no practical purpose.

Successful intervention at any point on the curve may result in a decrease in the population so it is useful to be able to indicate from what point on the curve the population has decreased *from*. These can be indicated by the letter *D* for a decreasing population. The number of species in this stage would be a measure of the success of previous strategies.

It does not matter whether the stages are named, but it is important to have the divisions in more or less the same relative place on the curve each time it is presented and to number them accordingly. Some RPMSs have attempted to relate the RPMS categories (with their rules) to specific stages on the invasion curve and the same approach is taken here. However, it is not realistic to suggest that all species in any particular invasion stage will always be in a particular category within a RPMS. This is because the invasion stage indicates only the spread of a species and not its risks, i.e. the potential effects to economic well-being, conservation etc. For example, ‘regional surveillance’ could apply to a species at almost any stage of the curve, depending on the state of knowledge of the risks and the feasibility of co-ordinated control. The threshold along the invasion curve for co-ordinated control and the nature of that control and associated rules will vary depending, in part, on the species and the risks it poses to the region as whole and to particular places, e.g. high-value sites.

5.1.3 Pest plant impacts

Pest plant impacts are an important component of weed risk. The *Act* makes it clear that for each pest included in the strategy councils must consider the current and future impacts on economic well-being, conservation values (indigenous species, ecosystems, and biological diversity), soil and water quality, human health and recreational values, and Maori culture. However, whether pest plant categories should be named according to the sector they are perceived to impact most heavily is doubtful. While it is useful to have the effects noted in the RPMS, to indicate why they are in the RPMS at all, it does not seem logical to me, to have some category of pest plants named according to the dominant effect, and other categories named on a different basis, e.g. the level of control. The alternative, of having categories named, e.g. ‘economic well-being pest plants’, ‘conservation pest plants’, ‘soil and water quality pest plants’, seems equally undesirable.

The process of ‘weed risk assessment’ is undertaken by some councils in conjunction with complex cost–benefit analysis but neither are dealt with here.

5.1.4 Population reduction

There are potentially only four possible approaches to a plant species population within the context of a RPMS.

- Prevent its entry to the area
- Eradicate it
- Contain it (locally and regionally)
- Only observe it (do nothing).

Some would argue that containment should be split into managerial categories differentiating reducing the extent of the population, from simply ‘holding the line’. Similarly, others have argued for a “zero density” category where there is a persistent seed bank or where there is high chance of re-infestation. However, on the ground, there is insufficient difference in what would actually be undertaken to warrant this subdivision.

The middle two options were implied in the classification of Class B plants under the Noxious Plant Act (1978).

- Target plants – to be eradicated
- Surveillance plants – plants that were thought to have been eradicated
- Widespread plants – plants to be controlled only where necessary.

The process for determining whether a weed should or should not be included in the RPMS is considered only briefly here, in Appendix 3.

Prevent entry

In the first instance, the aim should be to prevent a pest plant from entering the region as a whole. Prevention of entry is synonymous with quarantine. But quarantine in the minds of the public, applies mainly to the national border, or alternatively to national emergencies, e.g. the South Island during a foot and mouth disease outbreak. Because of this broader meaning, ‘quarantine’ should probably not be used at the scale of regions in New Zealand. ‘Exclusion pest plants’ is a term that has been used and it is probably the best one. These are likely to be mostly *unwanted organisms* under the *Act*. Because councils are legitimately able to eradicate any unwanted organisms, even if not listed in the RPMS, a good reason for listing them in RPMSs is probably for publicity purposes.

Eradication

To *eradicate* means the elimination of every single individual of a species from an area to which recolonisation is unlikely to occur, including propagules (Myers et al. 1998). In practice, these conditions are rarely met with at a national scale and infrequently at a regional scale compared with the large number of potential candidates.

A important recent study showed that the chance of a terrestrial plant species being eradicated declines rapidly after it has covered more than 0.01 ha (Rejmánek & Pitcairn 2002) and is unlikely for infestations greater than 100 ha (Panetta & Timmins 2004). In both cases, the figures refer to the gross total area that needs to be surveyed. Nationally there have been very few terrestrial plants eradicated from the whole of New Zealand (Ian Popay, DOC, Hamilton, pers. comm.) which confirms the above generalisations. Eradication of very small infestations has been achieved several times at a regional scale. The pattern for water plants at a national scale is similar, i.e. very few species have been eradicated (Paul Champion, NIWA, Hamilton, pers. comm.). However, regional eradication of water plants has been successful more often. This is partly because the total wild population can be delineated by the water body or catchments and control methods applied to all individuals.

The feasibility of eradication is a function not only of the area, but also of the practicality of control. Several factors contribute here, including biological aspects of the plant and the landscape in which it is infesting. For example, nassella tussock (*Nassella trichotoma*) will never be *eradicated* in Canterbury and Marlborough because it ‘hides’; as a seed bank, as juveniles too difficult to distinguish at an early age, and as adults that are barely distinguishable from silver tussock or are hidden in matagouri bushes (G. Bourdot, AgResearch, Lincoln, pers. comm.).

Widely cultivated plants where there is a conflict of interest between horticulturalists and RPMS objectives are also unsuitable for eradication targets (Panetta & Timmins 2004). Plant species that people would merely like to be able to grow, but which are not yet widely grown, would still be possible candidates. Many water plants are in this category.

Many RPMS have species where eradication is the intent and they are mostly listed as ‘Total Control Pest Plants’. If the goals of the RPMS are to be achievable, and if eradication is taken to mean just that, then only species at the very beginning of the invasion curve should be targeted for eradication, i.e. no further than Stage 3.

Is ‘total control’ a satisfactory term for a category of pest plants where the aim is eradication? I have two objections to this phrase in this context. Firstly, it implies there might be something called ‘partial control’, and while this might be the intent of an RPMS category, it would look strange to name a programme such. Secondly, some plant species are under ‘total control’ by regional councils and simultaneously under ‘eradication’ programmes by MAF. If terminology is to be consistent across the country, between organisations, and as far as possible between organisms (e.g. plants, diseases, birds), then ‘eradication’ is the better term, hence ‘eradication pest plants’.

‘Eradication pest plants’ (or ‘total control’) has usually been applied to a whole region but there are examples of RPMS reviews that suggest eradication can be achieved in one part of the region and not another. This is unlikely if a substantial propagule source was present elsewhere within the region, given the relatively small size of all the regions. It is probably

better to think of such eradication attempts at scales less than the whole region as containment programmes for *sub-regions*.

‘Total control’ has often been used in the past, not to indicate what is actually feasible, but the seriousness of the problem and the council’s commitment to the pest. These requirements can just as easily be indicated in the rules

Containment

Once a plant species’ wild population has reached a stage where it cannot be eradicated (Stage 4 and beyond) the remaining options, apart from do nothing whatsoever, are either simply watch it (and all that ‘watch’ implies) or to contain it. *Containment* is a weed management approach that aims to prevent an increase in the *current distribution* of a species by reducing the density of existing infestations and thereby the production of propagules (vegetative or seeds etc.) by which it might spread. This can be achieved only by using ‘control procedures’. ‘Containment pest plants’ seems to me to be the best term for this category. This term is independent of scale and can be applied to the region as whole, or a part of it, right down to an individual property. In time, and given a successful control programme, the population may be reduced in extent.

Pest plants are likely to have rules applied to them requiring the landowner to control the pest to some extent or another, if the council is not to undertake the work. This is where the term ‘total control’ does become useful: as a descriptor of a rule requiring land occupiers to remove all plants from all of their property, but in the case of nassella for example, it is still only containment at a local scale. Similarly, *boundary control* is the useful rule descriptor requiring landowners to remove pest plants from portions of their properties. Some council have rules requiring occupiers to allow access to their properties by the councils, or their agents, to undertake control at the council’s expense, but only for pests of very limited distribution. [Note, this is in addition to rules requiring access by council’s agents if the occupier has not undertaken the work required in an issued notice to comply.]

Other widely used terms

As far as the wild population is concerned, apart from doing nothing, ‘watching it’ may involve research and surveying its distribution through time. There may, or may not, be statutory obligations regarding these plant species. If not, and the species is included in the RPMS, then they are only *potential pests* (see 5.1.1). Those plant species that the land occupier is under no statutory obligation to control wild populations, but which are nevertheless in the RPMS as pests, are often called ‘regional surveillance pest plants’, sometimes without the ‘regional’. Note that merely banning plants from sale and distribution etc. will not reduce the *current distribution* but it may slow the rate at which a plant occupies its *potential distribution* by preventing the formation of new populations. RPMSs often state this explicitly as an objective of the *surveillance* category. The main objectives, then, of *containment*, and *surveillance*, as frequently used, is to minimise or reduce the effects of a pest plant by preventing the further establishment or spread. It is important to note that the risk imposed by this group of plants will range from low to very high. ‘Surveillance’ is also used to include plants thought to have been eradicated.

As far as wild populations are concerned, the primary difference between ‘containment’ and ‘surveillance’, as currently used in RPMSs, is the rules that apply in the various strategies. To my mind it is inappropriate to have the word ‘surveillance’ used to name a single RPMS

category. Surveillance is a part of weed management activity critical to successful outcome of all RPMS categories.

At the same time, pest plants that are so widespread that co-ordinated control has proved to be unjustified should not be placed in this category.

This problem is becoming increasingly complex as some RPMS add lists of plants from the NPPA to their ‘surveillance’ category, and others do not. As a result, some RPMS have two plant species in their ‘surveillance’ category and others have more than 20, yet many of the weeds present similar risks in the two (or more) regions. And another RPMS uses the term ‘restricted pests’ for those that are not yet declared *unwanted organisms* but otherwise have similar management status.

Another term frequently found in RPMS is ‘progressive control’, for pests where the aim is not to eradicate them but to reduce their density and or distribution, and often with the stated objective of reducing the population to a level where eradication is possible. Essentially this is *containment*.

I believe a far better solution than restricting the category name to one term qualifying pest plants (e.g. surveillance, total control), but as some have done, to use two words or more. In this case, the primary difference relates to the rules, and this leads to the next section.

5.1.5 Where the pest plant will be controlled

There is no escaping the logic that a pest plant can have statutory obligations and rules pertaining to it that apply over either the whole, or part, of the area under the RPMS.

If the *area(s)* is less than the whole region, then it is an area where there is a unique combination of defined rules that have the purpose of preventing or reducing the spread and effect(s) of a single or multiple species of weed(s), either to that area, or from that area. The RPMS may be referring to very large areas, having geographical boundaries (usually shown on a map) e.g. ‘Great Auk Island’, or ‘the area south of the Mamaku River’. A suitable term for these areas is probably *sub-regions*.

Pest plants may be controlled in *areas* not necessarily to prevent adverse effects within that area, but to prevent it spreading to an area where the risks are greater, e.g. control on the mainland to prevent spread to offshore islands.

At the same time, the RPMS may refer to a class or classes of areas with a greater degree of bio-physical homogeneity and defined values that may be affected, e.g. forest patches of high conservation value, or defined ownership, e.g. properties free (or with a low density) of a particular pest plants. In the biodiversity conservation sense these are termed *sites*, hence ‘site-led weed control’. Although this term has never been applied to agricultural pests when applying the rule of *boundary control*, the reasoning is much same, i.e. to prevent the site (the neighbouring property) being invaded by pests. However, rules pertaining to ‘boundary control’ are also used to prevent seeding onto roadways etc., which are not sites of any particular value, but the corridors along which pests can spread.

Sites may also be nested within defined *sub-regions*, e.g. forest patches within the sub-region defined geographically as the ‘South Canterbury sub-region’.

Sites (areas) may not necessarily be defined or delineated spatially at the time of the RPMS, but only allowed for therein, and to be defined during the course of the strategy, e.g. the area delineated when a community initiative project is launched. There may be legal issues here, but they are not debated in the context of this report.

Within a single RPMS there is often a range of objectives for different species in different places within a single category (e.g. ‘progressive control’). For example, the objective for ‘Weed A’ may be to stop it spreading from areas of high density within urban areas, where there is little or no control, into more rural areas of high conservation/landscape value, whereas for ‘Weed B’, the aim is to reduce its density within a sub-region to protect a wide range of values. Often the same species occurs in another category where different rules apply to the same species in a different sub-region (e.g. ‘boundary control’). These differing sets of rules applying to ‘progressive control’ in sub-region A, and ‘boundary control’ in sub-region B, taken together may be a sound strategy for the weed in the region as a whole. However, the scattering through the RPMS of both the objectives for the weed and the species being controlled in different sub-regions often makes it difficult to grasp the objectives as a whole both for individual weeds and for individual sub-regions. As a minimum effort to overcome this deficiency, RPMS should at some point bring all these components together in tabular form.

5.1.6 Responsibilities for controlling pest plants

Who might appropriately be responsible for controlling a particular pest plant will depend largely on the abilities of the exacerbator, and beneficiary of control, to pay for control. This is essentially a political issue, but in the case of pests, politics must be compatible with the stated goals of the RPMS strategy.

All the evidence suggests attempts at pest plant *eradication* at a regional or national scale will fail if the responsibility is left to the occupier, even if cajoled by council staff. All pest plants within RPMS where the stated objective is *eradication* should therefore be the responsibility of the councils. This approach is becoming more common in RPMSs.

Councils may also share responsibility for controlling pest plants with any occupier or groups of occupiers in all or part of the region.

One strategy category still seen in recent RPMS reviews is ‘boundary control pests’ where the objective is primarily to prevent the spread of a pest to land that is cleared, or is being cleared, of that pest. At first sight this appears to be a ‘where’ category, i.e. at the boundary of some undefined parcel(s) of land. In fact, it actually aims to identify a class of occupiers, sometimes within a sub-region only, who shall be required to control pest plants at the boundaries of their properties. ‘Boundary control’ is best considered simply as a rule aimed at *containment*, albeit on a local scale, as explained under 5.1.4.

One category of pest plants applying to a site (as defined above) is where the location of the site is determined by the level of community support for controlling the pest. For example, plant pests within a particular catchment. The Strategy describes the programmes and indicates the level of community support required to trigger a Council involvement, along with the associated rules of the category. Individual programmes could include a different set of pest plants at varying stages of invasion both in the whole region and in the vicinity of the site. Such programmes are likely to be found more widely in the future as community groups

take greater responsibility for their local environment. These are termed ‘community initiative programmes’.

That councils will include education and publicity material and activities involving all the plants in their RPMS should be taken for granted.

5.2 A decision tree for categorising pest plants

Here I have attempted to construct a logical tree for categorising all weeds listed in RPMS into four major categories: Potential Pests, Exclusion Pests, Eradication Pests, and Containment Pests (Table 1). These divisions are based primarily on the early invasion stages of the weed and the presence or absence of rules or statutory obligations. Suggested terms for the major categories are given at each step in the third column. Further differentiation is indicated by where the control is to be undertaken, who is responsible, and other rules or statutory requirements. Each of these components is separated by a ‘/’.

Table 1 Key for allocating a weed to the four major categories of RPMSs within the *region* or lesser area. The statement in the middle column is either true or false within the strategy, leading either to a category name in the third column, or back to another set of questions in the second column. * The overlap of stages in these boxes is intentional

Step	Invasion stage and presence/absence of rules	Category names and examples of components
1	1a. No legislative requirements or rules associated with the species	‘Potential Pest’
	1b. Legislative requirements or rules associated with the species present	2
2	2a. It is <i>only</i> an unwanted organism with no other associated rules	NPPA Plant
	2b. Rules are attached to the species	3 (All pest plants)
3	3a. It is not yet thought to have established in the region	‘Exclusion Pest’
	3b. It is known to be established in the region	4
4	4a. Stages 2–3	5
	4b. Stages 4–5	6
5*	5a. It is only at Stages 2–3 on the invasion curve and the council shall control it.	‘Eradication Pests’ / defined area / council shall control / banned from sale etc. and other rules
	5b. It is only at Stages 2–3 on the invasion curve and the council is not bound to control it	6
6*	It is at any stage from 2 to 5 on the invasion curve with no rules other than banning from sale etc. in the whole region	‘Containment Pests’ / area / banned from sale etc. / no other rules
	It is at any stage from 2 to 5 on the invasion curve with rules in addition to banning from sale etc. in all, or part, of the region	7
7	All other pest plants	‘Containment Pests’/ area / who is responsible / rules

For any individual weed or pest plant, the category may apply to an area encompassing the whole region, a sub-region, or to a site, and no differentiation is made at this point in the categorisation.

With the exception of ‘potential pests’, there are no new words used here that have not already been used in at least one RPMS or review, and in total there are many fewer terms than used in all these documents combined.

Table 2 Example of how the categories would be indicated for each weed is shown in Appendix 4

Category components and or pest status	Examples of some approximate historical or current terminology from various RPMS
‘Potential Pest’	Research Plants Surveillance Project
‘Exclusion Pest’	Exclusion Pests ‘Potential Pests’ not yet in the region
‘Eradication Pest’ / regional/council shall control / banned from sale etc. / other rules	Total Control Pests Limited species
‘Containment Pest’ / regionally / banned from sale etc. / no other rules	Surveillance Pests Regional Surveillance Pests Restricted Pests
‘Containment Pest’ / banned from sale etc. / applicable area / who is responsible / other rules*	Containment Pests Progressive Control Pest Boundary Control Pest Expanding species Entrenched species Suppression pests Biodiversity pests
<p>*Examples:</p> <ol style="list-style-type: none"> 1) Containment Pest / whole region / occupiers /total control 2) Containment Pest / Southern region / occupiers / boundary control 3) Containment Pest /specified high-value sites /council/total control 4) Containment Pest / community initiative in Onga Onga Valley / occupiers / total control <p>(also see Appendix 4)</p>	

5.3 RPMS layout

There are many issues that must be covered in RPMSs as explained in the Guidelines. The following are suggestions only for the order of explanation and presentation within the RPMS for those aspects of weeds discussed in this document.

5.3.1 Weed species

The first section would list all species included in the RPMS and cover details such as a description, their effects, the justification for inclusion in the strategy, their *current distribution* and *potential distribution* and an estimate of their ‘invasion stage’ etc. The level of detail would vary widely depending on the regulations and rules applying, but the latter would not be presented in detail here. It may or may not be appropriate to present the *area* etc., for each species at this point.

If deemed necessary, this would also be the place for presenting the beneficiaries and exacerbators, cross-referenced to the *areas* where applicable.

5.3.2 Category definitions

The second point would be to define the major category divisions, using the terminology presented here if that was acceptable.

5.3.3 Areas

The second section would describe the predetermined named *areas* to which different sets of regulations and rules apply. All maps pertaining to the region would be together. Existing ‘community initiative programmes’ would be mapped.

Any *sites*, whether presented on maps or not, would be described.

5.3.4 Responsibilities for control

These would probably be presented as a set of definitions elsewhere in the RPMS covering all classes of organisms covered by the RPMS.

5.3.5 Rules and regulations

These would be defined.

This information would then be brought together for each weed in tabular form as shown in Appendix 4. However, those weeds that had nothing more restrictive applied to them than banned from sale etc. within the whole region would want to be shown separately so as not to clutter the presentation.

6. Conclusions

A logical framework for determining and naming pest plant categories that could be applied by all councils was constructed, based on the concepts found in the existing wide range of terms. This should be seen as a ‘tool box’ that councils can draw upon for the appropriate terms when categorising plants in regional pest management strategy (RPMS). The system is consistent with the present understanding of the process of plant invasions and the strategies needed to deal with them. It is consistent with the *Act*, and other legislation the councils operate under, and should be comprehensible to those administering the RPMS and to the public.

7. Recommendations

The system proposed ought to be widely discussed by Councils and other interested parties and used as a starting proposal for a genuinely nationally accepted pest plant classification system.

8. Acknowledgements

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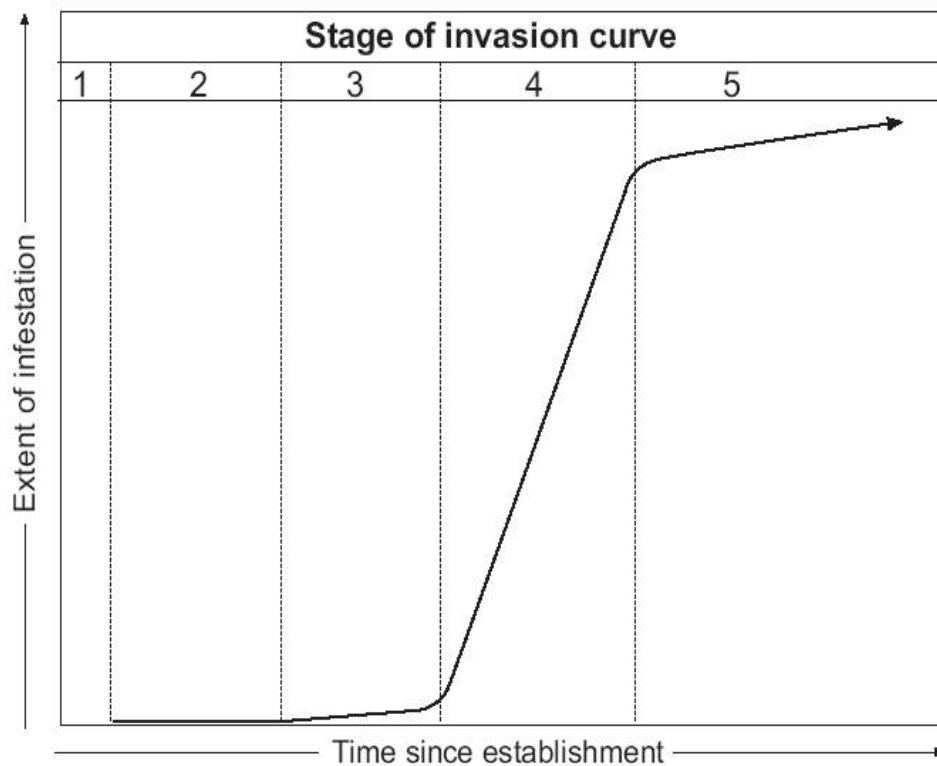
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Appendix 1 Descriptors of stages in the invasion curve (from Williams 1997)



Stage no.	Invasion curve slope	Distribution	Regional number of wild infestations and total area invaded ¹
1	Absent	Outside the region	None
2	Flat	Local	1-2, <100 ha
3	Starting upwards	Local	3-20, <1000 ha
4	Rising steeply	Region wide	20 +, >1000 ha
5	Levelling off	Region wide	Innumerable, >10 000 ha

¹ Defined as total area requiring surveillance delimited by the total extent of all known plants and their probable potential dispersal distance.

Appendix 2 Definitions

Act The Biosecurity Act 1993.

Area(s) The defined geographical extent where defined rules that have the purpose of preventing or reducing the spread and effect(s) of a single or multiple species of weed(s), either to that area, or from that area. Includes *regions*, *sub-regions*, and *sites*.

Boundary control A rule within an RPMS requiring the application of methods (e.g. mechanical, spraying) to reduce the density and reproductive output of a plant pest within a zone of defined width (e.g. 20 m) along the boundary of a property or *site*.

Co-ordinated control A strategic weed management programme that takes into consideration all occurrences of a weed(s) in a defined *area* and involves the application of *weed control* procedures towards a specific end (usually *eradication* or *containment*). Usually council led and promulgated as an RPMS under the *Act*.

Containment A weed management approach aimed at preventing an increase in the *current distribution* of a weed by using *weed control* procedures to reduce the density of existing infestations and limit the dispersal of propagules. Highly effective containment programmes may result in a decrease in the current distribution.

Current distribution The entire geographic distribution of a weed. In the case of an RPMS, confined to the *region*.

Exclusion pests *Pest plants* not present in the *region* that the proposer of the RPMS considers highly likely to enter the region and for which rules will apply if it enters the region.

Eradicate Elimination of every single individual of a species, including propagules, from a defined *area* to which recolonisation from beyond the area is unlikely to occur. Usually applicable only to an entire *region* in an RPMS.

Feasibility of co-ordinated control The ease with which effective *co-ordinated control* of a weed may be achieved. The higher the feasibility, the lower the resources required to undertake *co-ordinated control*.

Pest An organism included as a *pest* under the RPMS, as defined in the *Act*.

Pest plant A plant species declared a *pest* under the terms of the RPMS.

Potential distribution The geographic area that a weed could occupy if allowed to spread.

Potential pests Plant species included in the RPMS that are under investigation, including *surveillance*, as to their weed risk and feasibility of co-ordinated control, but are not classified as *pests*.

Region The total area over which the RPMS has effect. Usually a whole region as defined by the Local Government Act.

Site An *area* having described values (e.g. biodiversity, cultural history, agricultural production). These may or may not have well-defined boundaries at the time of the RPMS promulgation, but be represented by scattered geographical areas, e.g. islands or reserves, or land cover types, e.g. forestry blocks or riverbeds.

Sub-region Part of the *region*. Differs from *site* only in that it may not necessarily have defined high values, although the rationale for subdividing the region would be explained.

Surveillance The action of closely observing something: in this case, a plant species. It can apply to plants both in the wild and in cultivation.

Total control A rule within an RPMS requiring the application of methods (e.g. mechanical, spraying) to reduce the density and reproductive output of a plant pest over all the properties within a defined *area*, e.g. a *region*.

Unwanted organism Any organism the chief technical officer (under the *Act*) believes is capable of causing harm.

Weed A plant species (not necessarily non-native) that grow where they have unwanted consequences, e.g. in the context of the *Act*, effects upon economic well-being, indigenous biodiversity in the broadest sense, soil and water processes, human health and enjoyment of the environment, and the relationship of Māori and their cultural traditions with the natural environment, and other their traditions. Such species may be designated as *pest plants*.

Weed control Application of any number of methods that are designed to reduce the *density* and reproductive output of existing infestations.

Appendix 3 Determining weed management priorities

The determination of whether or not a species is to be included in an RPMS is a function of its weed risk and the feasibility of co-ordinated control. The factors to consider and the process of undertaking this analysis have been clearly explained in the *National Post-Border Weed Risk Management Protocol* (Anon. 2006) and so it is only outlined here.

The first part, analysing and evaluating the weed risk, involves identifying three criteria:

1. Invasiveness, e.g. reproductive ability
2. Impacts, e.g. competes with crops.
3. Potential distribution, e.g. the total area at risk if the weed spreads – often determined by climate/soil matching

These are then combined into a score. There are several systems in existence for doing this, ranging from the very simple to the highly complex. The latter may include detailed cost-benefit analysis. In the New Zealand context, they all need to take into consideration the requirements of the *Act*.

The second part involves analysing and evaluating the feasibility of co-ordinated control.

1. Current distribution, i.e. the total extent, number, and geographic arrangement of the infestations of a weed involving mapping
2. Control costs criterion, involving mainly the costs of detecting the weed, treating it, and achieving occupier co-operation. In the case of horticultural weeds, the likelihood of nursery and public co-operation needs to be considered
3. Duration criterion, undertaken to evaluate the time it would take to bring the weed under control, because the longer it takes the more expensive it will be

The determination of weed management priorities is a process of comparing the weed risk versus the feasibility of co-ordinated control. This can be presented as a matrix and a very simple example is given in Appendix 5.

Appendix 4 A representative portion of weeds in an RPMS

A fictional example of a framework format for an RPMS summary showing the species, the *areas* that apply to it, who is required to undertake control, and statutory requirements and control rules that apply to it. A key and further explanation is given below. Rules or their absence are shown as they might appear for species at increasing invasion stages throughout the region as a whole. Details of the *areas* and individual rules would appear elsewhere in the RPMS

Common name	Latin name	Statutory requirements and rules and where they apply			
		Whole region	Sub-regions and other areas	Outer islands	Onga Onga community initiative
Agapanthus	<i>Agapanthus orientalis</i>	Potential Pest			
Banana passion vine	<i>Passiflora mollissima</i>	Exclusion Pest			
Broom	<i>Cytisus scoparius</i>	Containment Pest / banned from sale etc. ¹			
Cape ivy	<i>Senecio angulatus</i>	Eradication Pest / council			
Giant reed grass	<i>Arundo donax</i>	Containment Pest / banned from sale etc. ¹	Total control / Council		
Gorse	<i>Ulex europaeus</i>	Containment Pest / occupiers / total control			
Jasmine	<i>Lonicera japonica</i>	Containment Pest / banned from sale etc.	Boundary control / occupier		
Monkey apple	<i>Acmena smithii</i>	Containment Pest / banned from sale etc.	Boundary control / occupier		
Pampas grass purple	<i>Cortaderia jubata</i>	Containment Pest / banned from sale etc.	Boundary control / occupier		Total control / occupier
Pampas grass common	<i>Cortaderia selloana</i>	Containment Pest / banned from sale etc.	Boundary control / occupier	Total control / occupier, DOC	Total control / occupier

¹ Banned from sale etc. Note, this rule applies to all sub-regions and areas where it occurs in the Whole region column, and also to all sub-regions and other areas where a more demanding rule applies, hence it is not shown in these columns to avoid clutter.

Appendix 5 Weed management matrix

A simple example of a weed management matrix for weeds present in the region and their allocation (or not) to a category within the RPMS. Based on Anon. (2005), but the 'negligible' category has been omitted from both axes.

		Feasibility of co-ordinated control over the whole region		
		Low	Medium	High
Weed risk	Low	No action	Potential Pest	Containment –regional / banned from sale etc. only
	Medium	Containment –regional / banned from sale etc. only	Containment – sub-regional / other rules	Containment – regional / other rules
	High	Containment – sub-regional	Containment – regional / other rules	Eradication – regional