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Managing weeds: assess the risk guide

A guide for assessing the risk for weeds at the early stage of invasion on public land in Victoria

2nd Edition

VICTORIA State Government | Environment, Land, Water and Planning

Photo credit

Cover photo: Areas of herbicide-treated Sicilian Sea Lavender (*Limonium hyblaeum*) amongst indigenous coastal vegetation at Cheetham Salt Works, Point Henry near Geelong, May 2012 (Photo by Kate Blood).

Other publications in this series:

Blood, K., James, R., Panetta, F. D., Sheehan, M., Adair, R., and Gold, B. (2019) Early invader manual: managing early invader environmental weeds in Victoria. Department of Environment, Land, Water and Planning, Victoria. ISBN 978-1-76077-317-5 (Print); ISBN 978-1-76077-318-2 (pdf/online/MS word).

Sheehan, M., James, R. and Blood, K. (2018) Looking for weeds: search and detect guide (2nd Edition). A guide for searching and detecting weeds at the early stage of invasion on public land in Victoria. Department of Environment, Land, Water and Planning, Victoria. ISBN 978-1-76077-039-6 (Print); ISBN 978-1-76077-040-2 (pdf/online/MS word).

Blood, K. and James, R. (2018) Looking for weeds: name and notify guide (2nd Edition). A guide for identifying weeds at the early stage of invasion on public land in Victoria. Department of Environment, Land, Water and Planning, Victoria. ISBN 978-1-76077-041-9 (Print); ISBN 978-1-76077-042-6 (pdf/online/MS word).

James, R. and Blood, K. (2018) Looking for weeds: delimiting survey guide (2nd Edition). A guide for planning and undertaking delimiting surveys for weeds at the early stage of invasion on public land in Victoria. Department of Environment, Land, Water and Planning, Victoria. ISBN 978-1-76077-045-7 (Print); ISBN 978-1-76077-046-4 (pdf/online/MS word).

Blood, K. and James, R. (2018) Managing weeds: decide the response guide (2nd Edition). A guide for determining the appropriate response to weeds at the early stage of invasion on public land in Victoria. Department of Environment, Land, Water and Planning, Victoria. ISBN 978-1-76077-047-1 (Print); ISBN 978-1-76077-048-8 (pdf/online/MS word).

Adair, R., James, R. and Blood, K. (2018) Managing weeds: eradication response guide (2nd Edition). A guide for planning and undertaking an eradication response to weeds at the early stage of invasion on public land in Victoria. Department of Environment, Land, Water and Planning, Victoria. ISBN 978-1-76077-049-5 (Print); ISBN 978-1-76077-050-1 (pdf/online/MS word).

White, M., Cheal, D., Carr, G. W., Adair, R., Blood, K. and Meagher, D. (2018). Advisory list of environmental weeds in Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 287. Department of Environment, Land, Water and Planning, Heidelberg, Victoria. ISBN 978-1-76077-001-3 (pdf/online).

Panetta, F. D. (2016) Environmental weed risk screen for Victoria: background and development. A report prepared for the Department of Environment, Land, Water and Planning, Vic. ISBN 978-1-76047-017-3 (Print); ISBN 978-1-76047-018-0 (pdf/online).

Victorian environmental weed risk database (2018), search online for 'early invader weeds'.

Prepared by Matt Sheehan (Wild Matters), Bec James (former WESI team) and Kate Blood (DELWP), with input from Bianca Gold (DELWP) and the WESI Steering Group (Nigel Ainsworth, Ben Fahey, Daniel Joubert, Stefan Kaiser, Sally Lambourne, Kate McArthur, Mark Whyte, John Hick and former members Simon Denby, Melodie McGeoch, David Cheal and Penny Gillespie). Guide series review and editing 2016 by Dr F. Dane Panetta, Bioinvasion Decision Support.

How to cite this document: Sheehan, M., James, R. and Blood, K. (2018) Looking for weeds: search and detect guide (2nd Edition). A guide for searching and detecting weeds at the early stage of invasion on public land in Victoria. Department of Environment, Land, Water and Planning, Victoria.

Printed by TDC3 Richmond.

ISBN 978-1-76077-043-3 (Print)

ISBN 978-1-76077-044-0 (pdf/online/MS word)

Accessibility

If you would like to receive this publication in an alternative format, please telephone the DELWP Customer Service Centre on 136 186, email customer.service@delwp.vic.gov.au or via the National Relay Service on 133 677 www.relayservice.com.au. This document is also available on the internet at www.delwp.vic.gov.au.

Contents

About this guide

You have found an unusual weed and worked out what it is. How do you know if it is a future problem? What risk does it pose where it is growing?

Invasive species management is an integral component of any landscape or reserve scale conservation program. This includes weed management.

Increasingly around the world, the benefits of preventing and 'nipping new weeds in the bud' before they become widespread are being appreciated.

About WESI

The Weeds at the Early Stage of Invasion (WESI) Project was created to promote these benefits and enable Department of Environment, Land, Water and Planning (DELWP) and Parks Victoria public land managers adopt this approach.

The WESI project focuses on high risk invasive species at the early stage of invasion that threaten biodiversity. We work with DELWP and Parks Victoria staff looking after public land anywhere in Victoria.

WESI is funded through the Weeds and Pests on Public Land Program. Project information and tools are available at: www.environment.vic.gov.au/invasive-plants-and-animals/early-invaders

Working within a framework

The WESI project has developed a decision making framework that guides public land managers through the process of dealing with invasive plants at the early stage of invasion (see Figure 1). This guide describes in detail a component of the larger framework.

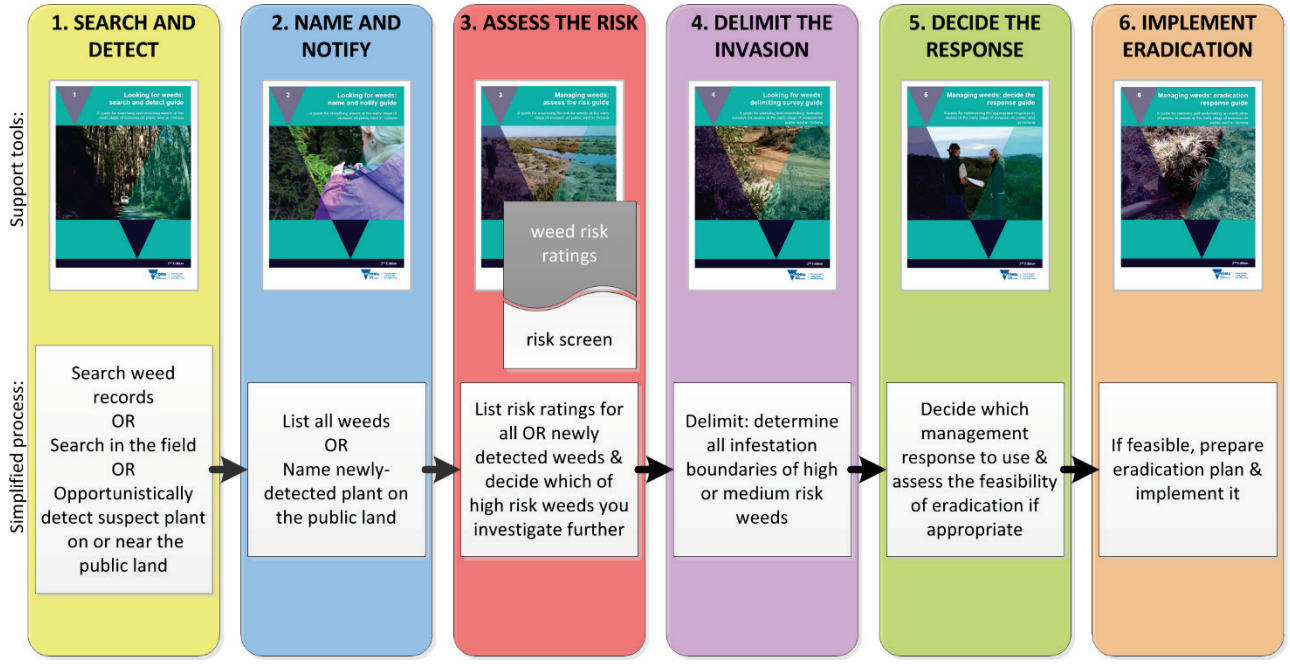

Figure 1 - This is the WESI decision making framework that guides the process for dealing with weeds at the early stage of invasion. There is an enlargement of the framework with scenarios in Appendix 1.

The guide series

Through research and trialling different approaches in the field, there is a growing amount of information about prevention and early intervention for weeds.

This document draws on that research and experience to offer a guide for public land managers, whether they do the work in the field, design the work or authorise the delivery of the work.

By using all the guides in this series, public land managers can improve their decision making about what are the highest risk weeds, how to search for and identify them, determine where the infestation boundaries are, work out which management approach is best and, where feasible, respond with local eradication.

The early invader guide series is one of a number of tools available through the WESI project. The series provides step-by-step guides to plan and undertake the following work:

- Search and detect
- Name and notify
- Assess the risk
- Delimit the invasion (comprising all infestations present)
- Decide the response
- Implement eradication (if appropriate)

A summary of the guide series is available with all the blank templates in "Early invader manual: managing early invader environmental weeds in Victoria" (Blood *et al*. 2019). The tools are available at: www.environment.vic.gov.au/invasive-plants-and-animals/early-invaders

Weed management including eradication

Weed activities fall into four broad categories: prevention, eradication, containment and asset-based protection. By better understanding these different management approaches, public land managers can make better decisions, invest resources more wisely, and have better biodiversity outcomes.

Eradication is the elimination of every single individual (including propagules e.g. seeds and buds) of a species from a defined area in which recolonisation is unlikely to occur (Panetta 2016).

There is no denying that eradication is hard to achieve, can take a long time and should only be undertaken for candidates that have a good probability of success. Using these guides will help you make better decisions.

Weed management should not simply be dismissed as 'too hard', but, through some careful planning and a continued and sustained response, can achieve great benefits for biodiversity.

What is 'in the early stage of invasion'?

There is ongoing debate about what area and number of infestations could be classified as eradicable. In reality, the answer depends on the weed and the situation because of the wide variation in the biology and ecology of weeds and the many different environments in which they grow. As a consequence, the relationship between the infestation area and the effort needed to achieve eradication will also vary (Panetta and Timmins 2004).

Through this guide series, we refer to 'weeds at or in the early stage of invasion'. The shortened term is 'early invaders'.

Early invaders are plants that have naturalised and have started to spread. Naturalised plants are non-indigenous species that sustain self-replacing populations for several life cycles without direct intervention by people, or despite human intervention. When spread has just begun, such plants are not at all widespread and are generally encountered only by chance, unless specifically targeted by search efforts. Co-ordinated management intervention, i.e. eradication or containment,

is at its most feasible for plants at this stage of invasion, owing to their highly restricted distributions (Panetta 2016).

The aim of this guide

The aim of this guide is to assist users with the process of determining the risk a weed poses at a site. This guide supports the 'Assess the risk' step in the framework shown in Figure 1. Use Figure 2 to help you navigate your way around this guide and the others in the series.

Before you start

These guides are full of different 'tools' and hints to help you through the weed management process. You may want to start at the beginning and work your way through step-by-step or browse for ideas in your topic of interest. Managing public land involves balancing many requirements of which weeds are only one.
Decisions about which weeds to manage must be made in this broader context. These guides lead you through the process to eradication of early invaders, but generally eradication will not be the aim for most weeds.

It is essential to be aware of the limitations of these guides, as well as the ongoing need for their modification in light of experience, intuition and local knowledge. Effective environmental weed management comes through long-term observations, learned skills and being able to make decisions based on the local conditions. These guides are to help, not substitute for, these important skills (Blood *et al*. 1996).

How do I assess the risk?

I want to assess the risk posed by a weed that is possibly at the early stage of invasion in my patch. Here is the process to follow.

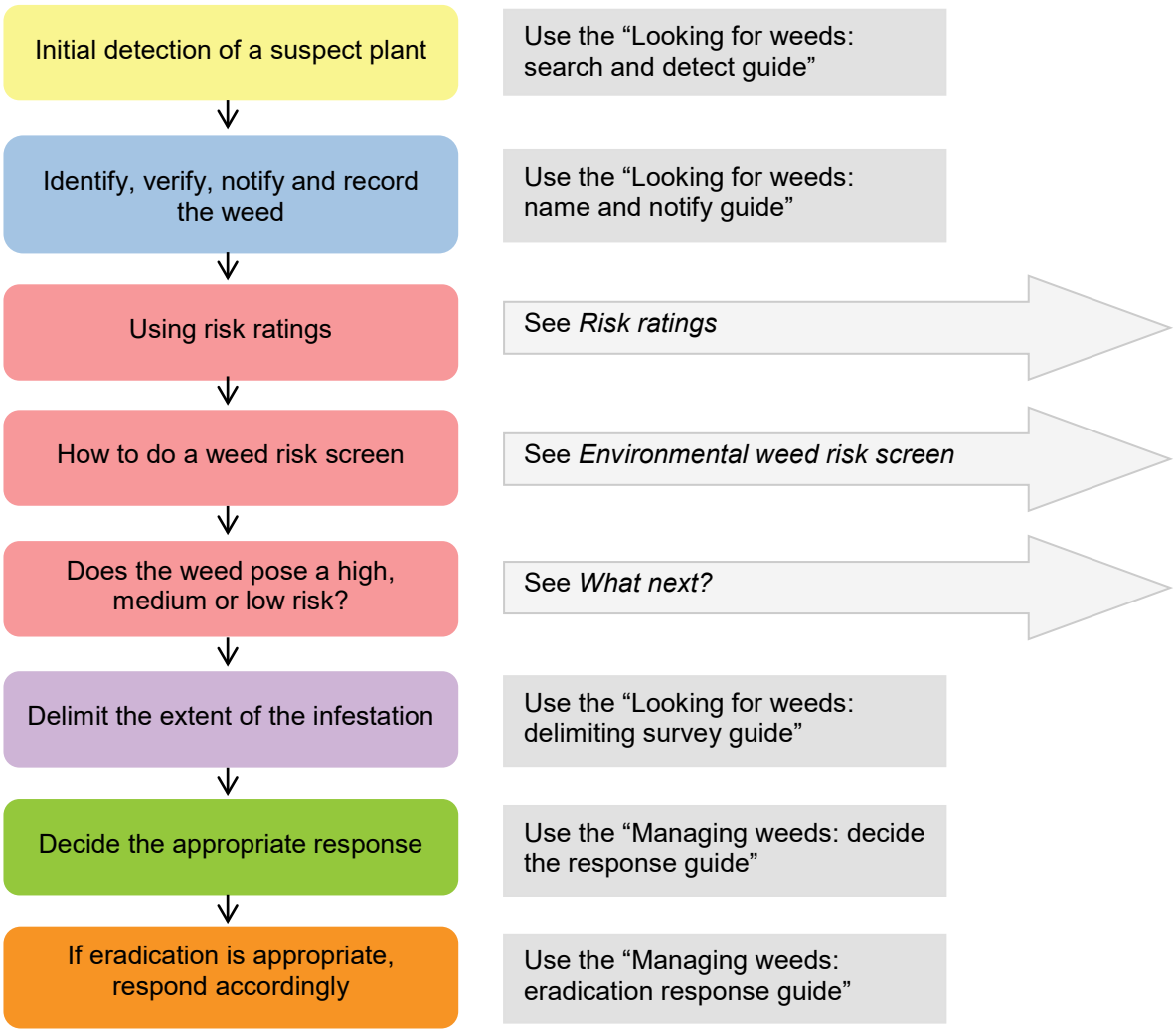

Figure 2 - How to use this guide.

Risk ratings

Risk ratings are useful to help work out which weeds pose the most serious threat.

Risk ratings provide an indication of the level of threat posed by a weed in Victoria. This guide is focused on the threat from weeds to biodiversity, particularly on public land. What are the weed's likely impacts and how invasive is it?

In the context of new detections, weed risk assessment (WRA) considers the probability that a plant will persist and spread (its invasiveness) and the consequences of such spread (its impact).

When to use risk ratings

The risk ratings can be used to:

- help determine which species are a higher priority to search for in and around public land;
- give risk ratings (when available) for weeds on public land;
- indicate the risk posed by a weed at the early stage of invasion, compared to existing weeds on the site; and
- assist in deciding if the weed is a target for eradication when used in conjunction with delimition (distribution) data.

If no risk rating is available

If you are looking for the risk rating of a weed that has not been assessed in Victoria, this guide describes a weed risk screening process that can help determine the risk the weed poses at a location (see next section). A template is available to prepare your own (see Appendix 2 and 3).

Risk ratings for Victoria

There are a number of sources of risk rating available for Victoria (Figure 3) listed below, summarised in Table 1 and detailed in appendices as listed below. Some are based on peer-reviewed references, others on the opinions of experts.

The risk ratings most commonly used by the WESI Project are from two main sources:

- Victorian Weed Risk Assessments (see Appendix 4) summarised in the Victorian environmental weed risk database; and
- Advisory list of environmental weeds in Victoria (see Appendix 5).

There are other risk rating sources for Victoria including:

- Department of Economic Development, Jobs, Transport and Resources (DEDJTR (to be replaced by Department of Jobs, Precincts and Regions (DJPR) on 1 January 2019)) Agriculture Victoria's Biosecurity rapid assessment procedure (see Appendix 6);
- Transformer weed list for environmental weeds (see Appendix 7); and
- Environmental weed risk to vegetation formations (see Appendix 8).

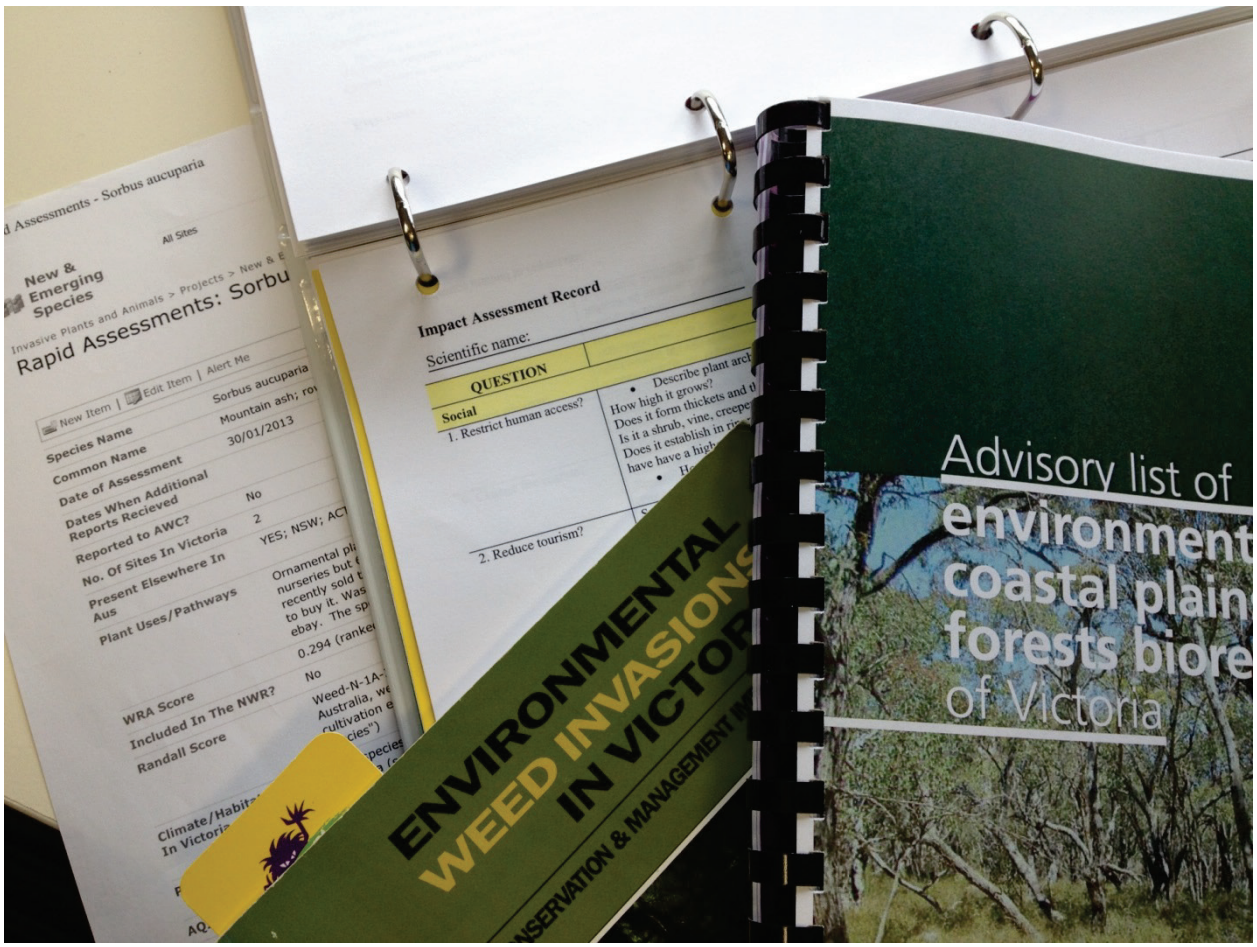

Figure 3 - Examples of weed risk rating documents. Image by Kate Blood, DELWP.

Table 1 - Weed risk ratings available in Victoria.

Weed risk rating process	Comments
Victorian Weed Risk Assessment See Appendix 4 for more information. DEDJTR Agriculture Victoria	A full Victorian Weed Risk Assessment (WRA) contains evidence-based (referenced) detailed information. There are components of the WRA that focus on invasiveness and impact on biodiversity. This information is likely to be the most comprehensive risk assessment for a weed. Since 2002, over 600 have been produced. Each weed is assessed against 41 questions, and a single weighted score is generated (pest plant score). This score can be compared to other weeds that have been assessed using WRA. 'Present' and 'potential' distribution maps are produced. It takes about a week to complete at a cost of $3,500 to $4,000 each. Insufficient information to complete a WRA (which is often the case for weeds new to Victoria) means the species cannot be assessed (determining feasibility of an assessment is about $1,000).
Advisory list of environmental weeds in Victoria See Appendix 5 for more information. DELWP	The advisory list was updated and expanded in 2018 to include early invaders, replacing five lists published in 2008-2009. It contains 1786 vascular and non-vascular plant species, including 1235 that are environmental weeds. The list includes a risk ranking score (between 0 and 33.3) for the weeds recorded in different bioregions. There are six risk ratings (very high, high, moderately high, medium, lower and potential risk). The information is the view of six experts, assessed against five questions.
Environmental weed risk screen See guide section and Appendices 2 & 3 for more information. DELWP	The screen was developed in 2015 to assess the weed risk posed by a plant that has been either newly detected, or has been known to be present for some time but not assessed previously. Its purpose is to provide a means for identifying the plants that pose the highest threat to biodiversity, particularly on public land at the local scale e.g. national park, conservation reserve, State forest.
Transformer species See Appendix 7 for more information. DELWP	The list of transformer species (weeds that have the ability to change ecosystems) contains 384 weeds that are the very high risk weeds from the environmental weed advisory lists published in 2008/2009. Information on these environmental weeds is used by Arthur Rylah Institute to spatially model areas in Victoria that are susceptible to invasion.
Biosecurity rapid assessment procedure See Appendix 6 for more information. DEDJTR Agriculture Victoria	Since 2009, new weeds recorded in Victoria are put through a Biosecurity rapid assessment procedure that focuses on agricultural and social impacts. Assessments contain some detailed information and attachments. Between 2009 and 2015, approximately 60 rapid assessments have been produced. Since April 2013, many contain ratings for High, Medium, or Low. The rapid assessment is used to determine if a species is of sufficient risk to warrant further investigation e.g. to undertake a full WRA.
Environmental weed risk to vegetation formations See Appendix 8 for more information.	In 1992, a group of three authors published a book titled "Environmental weed invasions in Victoria" (Carr *et al*. 1992). Included in the book is a table of 584 taxa (576 species). The table contains coded information, including a risk rating for each weed. The risk ratings used indicate the short to long term threat posed to one or more of 15 vegetation formations in Victoria, categorised as very serious, serious, potential, or not a threat.

Taxon (plural 'taxa') = A taxonomic group at any rank.

Using risk ratings

The two risk rating databases most commonly used by the WESI Project are:

- Victorian Weed Risk Assessments (see Appendix 4) summarised in the Victorian environmental weed risk database; and
- Advisory list of environmental weeds in Victoria (see Appendix 5).

Each of the *Excel* databases is a decision support tool that can assist in generating lists of detection priorities of existing and potential species in and around a parcel of public land at a particular date, helping to provide a structured approach to detection surveys on public land anywhere in Victoria. The scoring in each database is different so need to be used independently of each other.

The scientific names used are based on the Victorian Biodiversity Atlas (VBA).

How to use the risk rating databases

To use the risk databases, you will need to have a basic understanding of *Excel* software – how to open a file, sort, copy, delete and run a search. The user can copy the appropriate worksheet from either or both of the *Excel* files and then delete all the weeds that are not relevant to the public land under consideration.

By sorting the spreadsheet(s), it is possible to start prioritising weeds based on the comparative risk they pose. Remember it is only a guide. The spreadsheet(s) can be attached to the Spatial, Temporal, Activity Recorder (STAR) project you have created for this case.

For weeds that do not have a risk rating available, use the weed risk screen (see next section) to determine if the weed should be monitored for further change, or if a delimiting survey should be undertaken. It is possible to proceed through the decision making framework without a risk rating if a risk screen has been completed and it recommends ‘to delimit’.

If a weed list is not already available for a piece of public land, the spreadsheet(s) can form the start of such a list. Delete the weeds that are not relevant.

Where to find the risk rating databases

The risk rating databases are available on the external website (search for ‘early invaders Victoria weeds’), on STAR and on Enterprise Content Management (ECM).

The original risk database (formerly called the ‘prioritisation tool’) was developed with the assistance of Jackie Steel (DEDJTR Agriculture Victoria, Biosciences Research Division), Annette Muir (Arthur Rylah Institute) and consultant Simon Kennedy. There is an unpublished report detailing its development available on ECM:

> Muir, A. M. and Kennedy, S. J. (2014) Development of a new invasive plants prioritisation tool, for the new invasive plants and animals project: Final report. Arthur Rylah Institute for Environmental Research Unpublished Client Report for Port Phillip and Grampians Regions, Department of Environment and Primary Industries, DEPI, Heidelberg, Victoria.

If you are unable to access ECM, contact the WESI team (Appendix 11).

Environmental weed risk screen

Summary

Purpose: To assess the risk posed by a weed to biodiversity. The plant may have been either newly detected, or has been known to be present for some time but not assessed previously. The purpose of the screen is to provide a means for identifying the plants that pose the highest threat to biodiversity. It can be used for introduced weeds and non-local native species.

When to use the screen: The screen only needs to be used if a risk rating for the weed is not available in either the Advisory list of environmental weeds in Victoria, or the Victorian environmental weed risk database. If a weed is not in either risk database, double check that it is not under an old or a newer botanical name for the same weed. Use of the risk screen is optional and is a guide only.

Output: Recommendation to either delimit (determine the full extent in the field) or monitor. It does not create a score that is comparable to the advisory list.

Scale: Local scale such as, for example, a park, forest or reserve.

Where to find them: The screen process is described in this guide (below), a screen template is provided in Appendix 2 with a completed example in Appendix 3, and the completed screens should be stored on the Spatial, Temporal, Activity Recorder (STAR) attached to site/species related records.

Who can complete them?: Public land and biodiversity managers/practitioners or anyone with a basic knowledge of weed biology.

Overview

Some environmental weeds pose serious threats to the biodiversity values of natural areas. First detections of plant species occur relatively often at the local scale and this situation can be expected to continue. How should these species be managed? The answer depends on a number of factors, but the fundamental one is how great a threat a species represents, i.e. its weed risk.

In the context of new detections, weed risk assessment (WRA) considers the probability that a plant will persist and spread (its invasiveness) and the consequences of such spread (its impact). Current WRA procedures, while thorough, are too time-consuming and costly to address the potentially large numbers of plants concerned. They are also essentially 'desktop' activities that attempt to predict how a plant will behave in the field.

A simpler environmental weed risk screen is described in this guide. It has two components:

1. What is known about the behaviour of a species in other parts of Australia and elsewhere in the world (i.e. its *Weed History*); and
2. On-ground evidence of its invasiveness and impact where it has been detected (i.e. its *Local Performance*). Simple distance- and area-based measurements taken in the field are required for the latter component.

Weed History and Local Performance then are combined in a risk matrix to determine what to do next.

Management options for newly detected species include eradication, containment or indefinite control to a level at which biodiversity values are not significantly impacted. Another option is ‘no action’. Eradication is often an attractive proposition because of the prospect of a permanent solution to a problem that otherwise could exist in perpetuity. However, it may be an expensive undertaking and often success cannot be guaranteed.

The weed risk matrix (Figure 7) is used to derive a recommendation either to delimit the species (as a precursor to further determination of eradication feasibility) or to monitor it in the future in order to detect changes in its invasiveness and/or impact, should these occur. If practicable,

monitoring at yearly intervals is recommended. The logic behind the risk matrix is built into the weed risk screen score sheet so it's easy to use – just complete the questions in the template and a recommended action is given.

Using the environmental weed risk screen score sheet (template in Appendix 2) should require at most a day's effort per species. Even if a full WRA or some other risk rating has been completed for this weed in Victoria, the environmental weed risk screen can be used to give a more local perspective.

The Victorian environmental weed risk screen was developed in 2015 by Dr. Dane Panetta and the background logic and information about its development (Panetta 2016) is available on ECM by searching for: "Environmental weed risk screen for Victoria: background and development".

The Victorian environmental weed risk screen is put into context with the Victorian Weed Risk Assessment process in Figure 4.

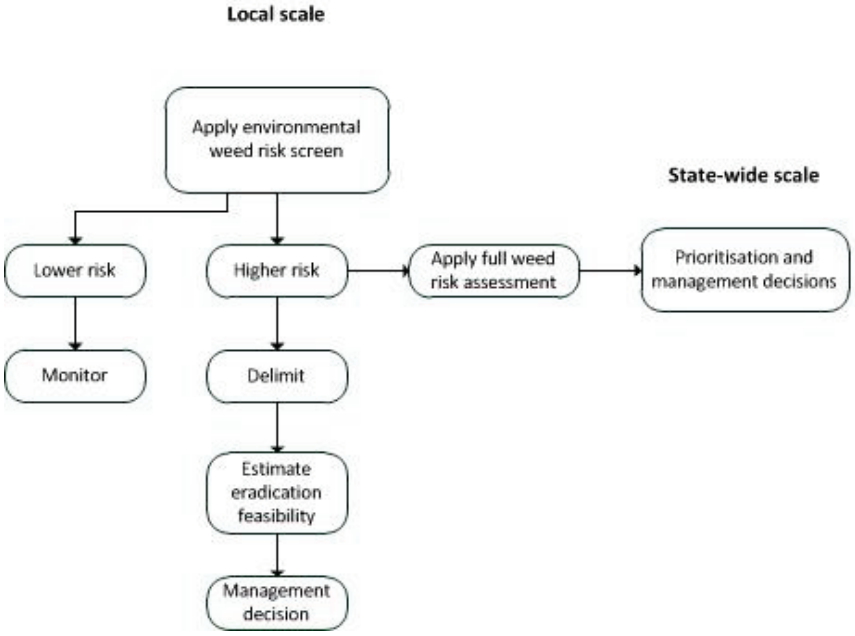

Figure 4 - Place of the environmental weed risk screen in the management of post-border weed risk in Victoria. The screen is designed to support risk assessment and risk management at the local scale. In order to make decisions on a larger scale, or to address other values (in addition to biodiversity), a full WRA will be required.

Using the screen

The screen described below comprises two components: Weed History and Local Performance. These are first assessed separately and then combined in a weed risk matrix. This matrix contains four combinations of different levels of evidence (i.e. low and high) for each of these components (see Figure 7).

Weed History

For this component of the screen, "A Global Compendium of Weeds" (Randall 2012, or more recent editions) is used to determine in how many regions of the world the species of concern has been recorded as an **environmental** weed. (It is assumed that a formal identification of the plant concerned has already been made.)

References in the Compendium are numbered and associated with a letter that indicates the status of the plant (e.g. A = agricultural weed, C = cultivation escape, N = naturalised etc.). References for environmental weeds are designated by an 'E' following the reference number; note 'E' references only. There are 60 pages of references in the Compendium, so for ease of use it may be worthwhile printing off these pages (as double-sided copy) if many assessments are to be undertaken.

While searching for information in the Compendium, it is important to note whether synonyms for the species exist (this information is given) and to determine whether additional 'E' references are associated with these names. Any references linked with 'global' locations should be ignored, unless the user has access to the original source and can determine the geographic origin of specific records. Records that correspond to lists of potential weeds should also be discounted, unless, again, primary sources can be accessed to determine whether these lists include any **actual** records of occurrence. Some of these references will have URLs, making such access easy.

Record the number of world regions in the weed risk screen score sheet (Appendix 2) for example Africa, Australasia (i.e. Australia and New Zealand), Caribbean, Europe, North America, Pacific, South America and Subantarctic.

Note that the scoring system presented may be also used for new detections of **native** species, for instance native plants that have been introduced from Australian regions in which they are indigenous.

Local Performance

The purpose of this component of the screen is to employ on-ground observations to determine through evidence of early spread and impact whether the candidate species poses a high risk to biodiversity values. In conjunction with information on the candidate's Weed History, assessments of invasiveness and impact from this component will then be used to decide whether to delimit the species or to monitor it, pending further evidence of spread and impact. The values of the measures employed in the assessment of Local Performance are qualified according to how long the species is considered to have been present (i.e. the time-related filters) and whether it occurs only in areas affected by disturbance (i.e. the disturbance filter).

Measures

As was noted earlier, the purpose of risk assessment (and risk management) is to identify and either avoid or reduce a hazard, which in this instance is impact upon biodiversity. The primary consideration here is field observations that indicate that the species could have adverse effects upon biodiversity, both where it is found and over a wider area through spread.

M1 Invasiveness

This component requires you to determine whether the plant has spread vegetatively, by seed or via both mechanisms. You are asked to make simple measurements in relation to these possibilities. It may be difficult to identify seedlings when these are isolated, but it should be possible to get some idea of seedling identity, based upon the fact that most seedlings will appear close to parent plants. Should seedlings be detected, information on the pre-reproductive period (i.e. juvenile period) of the plant will give some idea of potential rates of spread—plants with shorter life cycles will spread more quickly than those with longer life cycles, all other things being equal.

Propagules are structures that can grow into new plants. These are commonly seeds, but also include detachable vegetative structures such as stem segments, bulbils, and aerial tubers. Vegetative reproduction can occur via such detachable structures, but more commonly occurs via joined vegetative structures, such as roots, rhizomes, stolons or creeping stems. The latter contribute to local spread, whereas seeds and detachable vegetative structures can be dispersed more easily, thereby contributing to spread over larger areas.

M1a Evidence of reproduction

M1a1 Has the plant reproduced in place by joined vegetative structures (e.g. local spread via roots, rhizomes, stolons or creeping stems)?

Reproduction via detachable vegetative structures is considered to be functionally similar to reproduction via seeds and is covered under the next question.

Yes = score 1

No = score 0

M1a2 Has the plant reproduced by seeds or detachable vegetative structures (e.g. stem segments, bulbils, and aerial tubers)?

Yes = score 2

No = score 0

M1b Pre-reproductive (juvenile) period

How long does it take for a new individual to produce seeds or other propagules?

The answer to this question will give some idea of the potential rate of spread of the species. Plants with shorter life cycles will, in most cases, spread faster than those with longer life cycles, thus increasing the likelihood component of weed risk. Time to reproduction will be closely related to growth form, with annual species reproducing in less than 1 year, most herbaceous perennials reproducing in 2 years or less, and most woody species requiring more than 2 years to mature. Additional information relating to time to reproduction for individual species may be found through internet searches (see list of databases and websites in Appendix 9).

Less than 1 year = score 3

1 to 2 years = score 2

More than 2 years = score 1

Default for shrubs and trees = score 1

M1c Evidence of spread

M1c1 For joined vegetative spread:

Spread to less than 1 m = score 0

Spread more than 1 m = score 1

M1c2 For spread via seed or detachable vegetative propagules:

Where seedlings and other young plants are present and can be linked with presumed parent plants, it is important to gain some idea of how far from parent plants that seedlings have established. Seedling numbers and density generally decrease rapidly with increasing distance. It is not the aim of this question to determine the furthest extent of seedling establishment—this would be an objective of delimitation. Rather, the aim is to determine whether seedling recruitment has occurred at a substantial distance during the time for which the plant has been present.

Note that while working in the field collecting this information, there is a risk of spreading weed propagules. You should also look after your personal wellbeing and safety (see Appendix 10 for information on hygiene and safety).

To answer this question, walk for approximately 100 m in different directions away from the presumed parent, noting when the last seedling or young plant is detected. *For the direction in which plants are detected at the greatest distance*, score as follows, where final detection occurs at:

Less than 10 m = score 1

10 to 50 m = score 2

More than 50 m = score 3

For guidance, maximum potential invasiveness scores for plant growth forms are shown below in Table 2.

Table 2 - Maximum invasiveness scores for different terrestrial plant growth forms.

Question	Growth form					
	Annual	Biennial	Herbaceous perennial*	Shrub	Tree	Climber
M1a	2	2	3	3	2	3
M1b	3	2	2	2	1	2
M1c (veg. spread)	na	na	1	1	1	1
M1c (other spread)	3	3	3	3	3	3
Total	**8**	**7**	**9**	**9**	**7**	**9**

*Includes aquatic plants; na = not applicable

M2 Impact

The highest risk plant invaders (sometimes referred to as 'ecosystem transformers'; Richardson *et al*. 2000) are those that change the character, condition, form or nature of ecosystems, particularly over large areas. This commonly happens when a new layer of vegetation is created by the introduction of a different growth form (e.g. the establishment and proliferation of shrubs in grasslands or wetlands, climbers that scramble over other plants, floating or submerged aquatic plants that can form monocultures).

The impact on biodiversity values is a function of plant cover and total biomass. Because total biomass can be difficult to measure, the cover of a plant is commonly used because it is closely associated with impact. ***Here, the assessment of cover is intended to capture plants that "sound an alarm bell" for the observer, indicating that a plant is on the way to becoming dominant, at least locally.***

M2a Could species *potentially* alter community structure?

This question needs to be interpreted in terms of the growth form of the species and the vegetation structure of the community concerned. Common transformations of community structure are conversion of grasslands or grassy woodlands to communities that have a dominant (invasive) shrub stratum, degradation of forests by climbing plants that overtop trees, and domination of the ground layer by creepers (e.g. *Tradescantia*) that develop monocultures that suppress regeneration of other plants. Aquatic plant invaders may form a floating monoculture (e.g. Water Hyacinth) or dominate as submerged plants (e.g. *Cabomba*).

To answer this question, consider all the community types that exist in the land unit that is being managed—where the plant occurs now may not be where it could have the greatest effect should it spread. Assistance in answering this question may be found through internet searches based upon the species name as well as through examination of a range of websites and databases (see list of databases and websites in Appendix 9).

Score the answer to this question as 'yes' or 'no', where:

Yes = score 5

No = score 0

M2b Has the plant attained a high level of cover?

Cover is the preferred measure of abundance cover and is defined as the proportion of ground occupied by perpendicular projection onto it by the aerial parts of plants. It is usually considered in the horizontal dimension, but for climbers the vertical dimension must be considered as well.

Cover is a better measure than density which is calculated in terms of the number of individuals per unit area and can vary widely depending on the age or condition of the plants.

Locate a dense patch of the infestation and record its cover to answer the question below.

This question will be answered as 'yes' or 'no', where 'yes' corresponds to 50% cover over a 2 X 2 m area for species reproducing vegetatively (via structures joined to parent plants), and over a 5 X 5 m area for those reproducing by seed or other propagules. If the plant reproduces by both methods, record the cover that has been achieved through vegetative spread.

Yes = score 10

No = score 0

If the recommended sample areas (2 X 2 m = 4 m^2 or 5 X 5 m = 25 m^2) are not available, slightly (e.g. 10-20%) smaller areas can be used; otherwise it will be necessary to monitor the infestation for future increases in cover. If practicable, monitoring at yearly intervals is recommended. The maximum score for impact (i.e. M2a + M2b = 15) is greater than the corresponding score for invasiveness (i.e. M1a + M1b + M1c = 10), giving greater weight to impact, which is consistent with the Victorian WRA procedure.

Filters

F1 Time-related filtering

The Local Performance assessment represents a snapshot, taken in the context of processes (i.e. invasion and generation of impact) that may or may not be in train. The amount of information conveyed in this snapshot, as well as the degree of uncertainty associated with the assessment, depend upon how long the plant in question has been present. Residence time is used, together with the juvenile period of the species (i.e. how long it takes a plant to produce seed or other propagules for the first time), to form a judgment on whether a species has had sufficient time to begin to express weed potential. If a plant has been known to be present for a long time, yet has neither increased in abundance nor spread, this also has relevance to the assessment of its weed risk.

F1a Residence time

How long has it been since first detection of the plant?

In many cases, land managers may have detected a species recently, prior to having it formally identified. In other cases, a plant may have been known to occur locally for some time but has become concerning because its population dynamics appear to have changed—it has begun to increase in numbers and spread after a period of no apparent change. The aim of this question is to capture whatever information is available about the period for which the species has been present.

Less than 1 yr = score 1

1 to 2 yrs = score 2

Between 2 and 5 yrs = score 3

More than 5 yrs = score 4

Default values = 1–2 years for biennial or perennial herbaceous species (includes aquatic plants) and 2–5 years for woody plants, based on the assumption that plants will have required sufficient time to become reproductive prior to formal identification.

F1b Pre-reproductive (juvenile) period

As discussed under M1b above, the time that a plant requires to become reproductive is a critical determinant of both its potential rate of spread and how quickly its impacts can be expected to accumulate. The emphasis here, however, is on whether a species has been present for sufficient time to begin to realise its weed potential.

How long does it take the plant to produce seed or other propagules for the first time?

Less than 1 yr = score 1

1 to 2 yrs = score 2

More than 2 yrs = score 3

F1c Comparing values for individual filters

Answers to the questions posed above are used to determine whether residence time exceeds the pre-reproductive period for the species, i.e. if the plant has been growing for longer than its pre-reproductive (juvenile) period. Low values for both the invasiveness and impact measures will be associated with **high** uncertainty if the plant has not been present for long enough to reproduce

and **medium** uncertainty if it has (see Figures 6 and 8). The level of uncertainty will affect the degree of confidence associated with consequent management decisions.

Is the number for F1a (residence time) greater than that for F1b (juvenile period)?

Yes (uncertainty = Medium)

No (uncertainty = High)

F2 Disturbance filtering

A critical aspect of invasiveness for environmental weeds is the ability to establish in intact vegetation (Virtue *et al*. 2006). Many species should be able to establish and increase in areas that experience a high degree of disturbance, but plants able to establish and spread in relatively intact vegetation will pose the greatest threat to biodiversity values. The aim of this filter is to assist in identifying the latter group.

Disturbance is a complex topic, in particular the distinction of 'natural' disturbance regimes from those that are dominated by human activities. Some types of natural disturbance are associated with particular habitats, e.g. flooding along watercourses and in wetland habitats, or with particular types of vegetation, e.g. highly flammable vegetation that is prone to fire.

Where fire is concerned, the human 'footprint' may be large, operating via prescribed burning or other intentional (arson) or accidental causes. For the purposes of this screen the nature of the fire regime is not important, only whether the site that the species of concern is invading has been burned recently. Where stands of natural vegetation are located adjacent to a different type of land use (e.g. agricultural land) or are associated with infrastructure such as roads and tracks, the effects of human-induced disturbance are commonly referred to as 'edge effects'.

The distance over which edge effects operate will vary according to vegetation type, but for forests, where light is the most important factor, the incidence of weeds drops noticeably by 10 m away from the edge. Because it is not always a simple matter to determine to what distance edge effects persist, especially for communities other than forests, distance from an edge plus the presence of disturbance-adapted introduced species are employed to evaluate the importance of human-related disturbance. Linear reserves, such as those occurring along roadsides, have high edge-to-area ratios. If such reserves are sufficiently narrow they may be subject to edge effects throughout.

*F2a Does the plant occur **only** in areas that have been recently (i.e. within the past few years) subjected to disturbance or are adjacent to an edge between natural vegetation and another land use?*

Yes = score 1

No = score 0

F2b What is the maximum distance that the plant (including seedlings) occurs from an edge?

Only edges between natural vegetation and other land uses (e.g. roads, tracks or agricultural land) are considered. Distance from the edge is measured **into** the natural vegetation, not in the other direction. Note that if reserves are narrow there may be no area that is free from edge effects.

Use the information gathered under question M1c to assist in answering this question.

Less than 10 m = score 3

10 to 20 m = score 2

More than 20 m = score 1

F2c Is the plant associated with other species that are commonly considered indicators of disturbance?

Such species will generally be annuals and other early colonisers. Common colonisers of edges, whether they occur next to agricultural land or roads and tracks, include Yorkshire Fog (*Holcus lanatus*), Perennial Veldtgrass (*Ehrharta calycina*), Large Quaking-grass (*Briza maxima*), Spear Thistle (*Cirsium vulgare*), Smooth Cat's Ear (*Hypochoeris glabra*), Cape Weed (*Arctotheca calendula*), Kikuyu (*Pennisetum clandestinum*) and Flax-leaved Broom (*Genista linifolia*). Indicators of other types of disturbance are too many and varied to be listed here. If in doubt, answer 'no'.

Yes = score 1

No = score 0

Decision trees

The decision tree presented in Figure 5 is based upon the scores for invasiveness and impact, plus a score for the disturbance filter. When scores for either invasiveness or impact are less than critical values (5) and the disturbance score is less than 4, there is insufficient evidence for the realisation of a threat to biodiversity values. This is because the plant occurs only under conditions of disturbance, with no evidence (as yet) for its ability to establish and spread in intact vegetation.

The cut-off value for invasiveness (5) corresponds to situations where a plant may reproduce both vegetatively and through the production of propagules, has a long juvenile phase and seedlings, where present, are less than 10 m from a parent plant. The cut-off for impact (5) corresponds to the situation where a species may have **the potential** to alter community structure owing to its growth form, but there is no evidence that it has produced sufficient cover to begin to realise this potential. The cut-off value for the disturbance filter (4) corresponds to the situation where the plant occurs only in areas that are disturbance-affected, perhaps with other disturbance-adapted species, and/or only within 10 m of an edge.

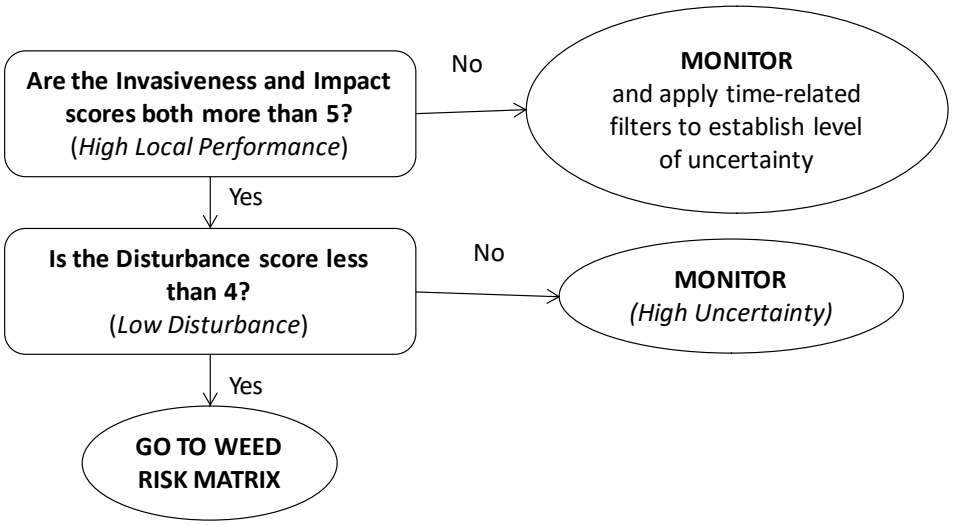

Figure 5 - Decision tree for *Local Performance* evidence, based upon the scores for invasiveness and impact, and the habitat filter (disturbance). High uncertainty associated with the decision to monitor when the Disturbance score is 4 or more exists because there is insufficient evidence to form a judgment on the ability of the plant to invade and cause impact in relatively intact vegetation. If practicable, monitoring at yearly intervals is recommended.

If the scores for invasiveness and impacts are below the cut-off values, this might occur because the species has not been present for sufficient time to demonstrate its potential as a weed. As has been discussed earlier, observations on invasiveness and impact must be interpreted in terms of residence time. In the context of the present screen, if there has been insufficient time for a plant to reproduce there will be no better basis for estimating its local weed risk than the methods that would be employed prior to its introduction (see the Weed History component of the screen). This will be more of an issue for species with relatively long periods between germination and maturity, such as some shrubs and many trees. The time-related filters (residence time and growth form) are combined to provide an estimate of uncertainty associated with the Local Performance evidence (Figure 6).

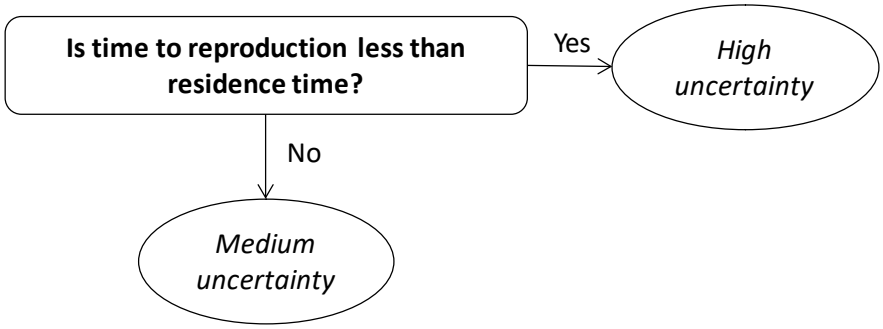

Figure 6 - Determination of level of uncertainty associated with Local Performance when the combined scores for invasiveness and impact are below the cut-off value (5). Low values for both the invasiveness and impact measures will be associated with high uncertainty if the plant has not been present for long enough to reproduce and *medium* uncertainty if it has. *Higher* uncertainty where residence time is less than time to reproduction reflects a lack of opportunity for the plant to become invasive and cause impact.

Weed risk matrix and associated management actions

Different combinations of low and high values for Weed History and Local Performance produce a 2 X 2 weed risk matrix, in which the relative level of each type of evidence varies between cells (Figure 7).

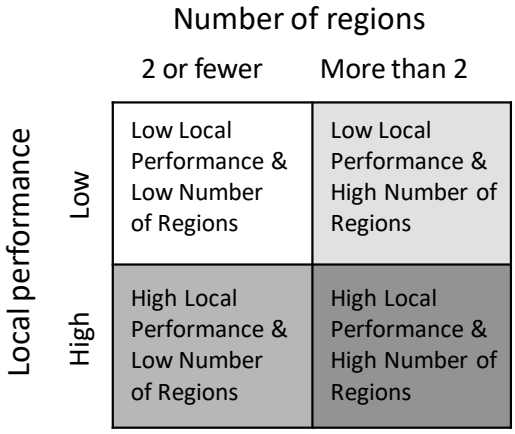

Figure 7 - Weed risk matrix representing different levels of evidence for both Local Performance and Weed History (number of regions). The shading intensity for combinations of evidence varies in order from the least (no shading) to the most (heaviest shading) evidence overall.

Many species that will be encountered may have been introduced repeatedly around the world, having had ample opportunity to naturalise, become invasive and to cause negative impacts. However, the possibility remains that a plant that has little previous history of introduction will be encountered.

Because the screen must have the capacity to identify threats to biodiversity from species that have no weed history, Local Performance evidence is given more weight in the determination of management actions. In both cases where Local Performance evidence is strong, the choice of delimitation is associated with a low level of uncertainty (Figure 8). Uncertainty is also low in the case where both Local Performance and Weed History evidence is weak, in which case the recommended action is to monitor so that there will be grounds to reassess the species in the event that local performance changes. If practicable, monitoring at yearly intervals is recommended. Where Local Performance evidence is weak and Weed History evidence is strong, the recommended action is to monitor, associated with either medium or high uncertainty, depending on whether or not residence time exceeds time to reproduction for the plant in question (Figure 6). Many so-called 'sleeper weeds' (Grice and Ainsworth 2002) would fit into this category.

Management actions associated with this category will be considered further under the concluding remarks over the page.

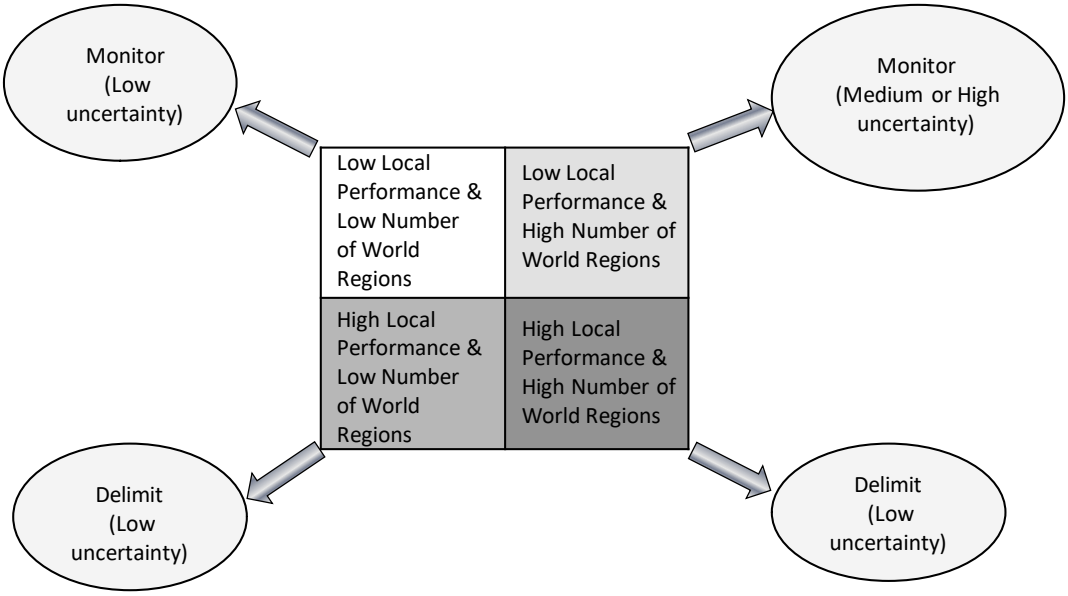

Figure 8 - Management actions and associated levels of uncertainty for different combinations of Local Performance and Weed History evidence. When uncertainty is low, the land manager can have more confidence that the management decision is a correct one than if the level of uncertainty is medium or high.

Concluding remarks

Choosing which species to delimit is basically a matter of 'picking winners'. The cost of getting it wrong is described by economists as an 'opportunity cost', referring to the fact that, given a decision is made to delimit the species, resources allocated to its delimitation might have been better invested in the delimitation of another species if the plant does not in fact pose a high risk to biodiversity values. The Weed History component of the present screen is a hedge against making such an error. However, the particular combination of high levels of weed history evidence with low levels of local performance evidence remains problematic. According to the current weed risk matrix (Figure 8), the recommendation for this category (which could include so-called 'sleeper weeds') is for further monitoring rather than delimitation. Additional investigation (e.g. through exploring sources on the internet) on a species-by-species basis may support a decision to delimit some species in this category, employing a precautionary approach.

The practice of targeting sleeper weeds is based upon a belief that even though such plants may not be demonstrating signs of weediness locally, they are worthy of an eradication attempt before they begin to spread, or at least have spread noticeably. Harris and Timmins (2009) have provided a provocative bio-economic argument that, as long as plant invasions are small enough to be feasible as targets for eradication, it is worth attempting to eradicate all or most newly detected ones, even though only a small proportion would be likely to generate serious impacts. However, the hard reality is that the resources available for delimitation, feasibility evaluation and further action will likely restrict the number of candidates that can be tackled in practice.

Calibration has been undertaken for the screen's Weed History component, but its Local Performance component cannot be tested until it has been applied in a range of locations. This component will most likely be capable of refinement and improvement with use. Of most immediate concern are the cut-off cover values for impact (i.e. 50% cover over a 2 X 2 m area for plants reproducing vegetatively and over a 5 X 5 m area for those reproducing by seed). These are 'best-guess' estimates, but application of the screen should soon indicate whether they are reliable and robust. In addition, for species with longer juvenile periods (e.g. some shrubs and most trees) there may be situations where seedling density measures are more effective in capturing impact potential.

What next?

Where are you up to?

At this stage you have determined the risk posed by the weed(s) you have detected. You have decided which weeds you will now delimit and which ones you will monitor to see if there is further change.

If, due to limited resources, you need to further prioritise the species you are considering before proceeding to delimiting surveys (i.e. you have too many species to delimit), consider the total area covered by each species rather than the number of its infestations. The risk of removing species before going onto the next step is that you may accidently remove species whose feasibility improves after delimitation.

Planning what to do next

The next step is to delimit the infestations. Use the following guides (see Figure 9) with the help of the WESI team (see Appendix 11):

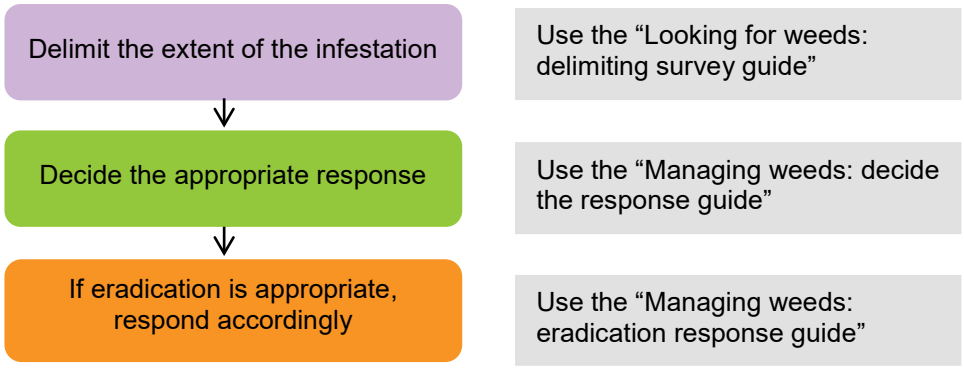

Figure 9 - Planning what to do next.

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Appendix 1 - Decision making framework (including scenarios)

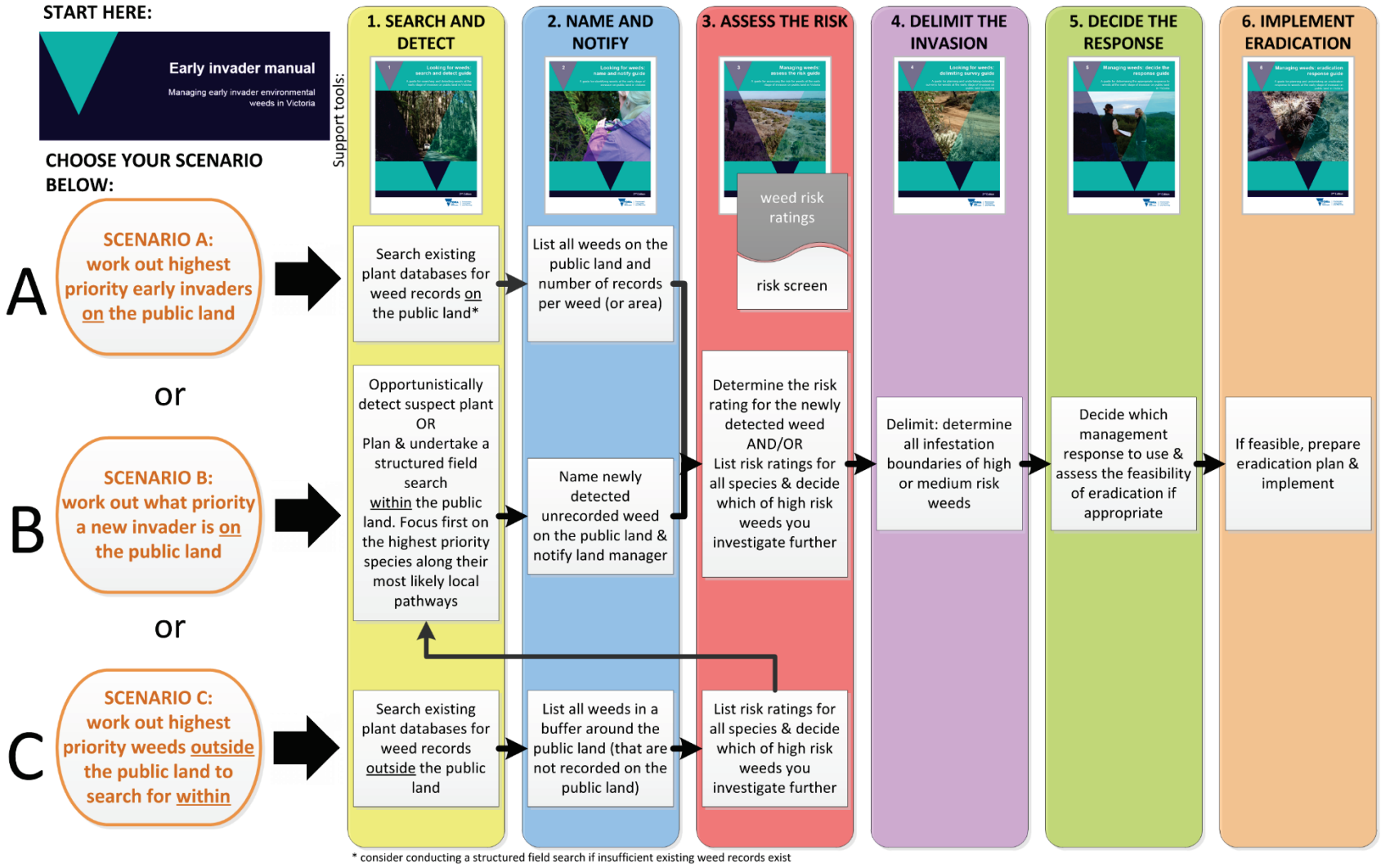

Figure 10 - This is the WESI decision making framework that guides the process for dealing with weeds at the early stage of invasion. This version illustrates three typical scenarios faced by public land managers.

Appendix 2 - Environmental weed risk screen score sheet template

Note: Use is optional and only required if a risk rating is not available in either the Advisory list of environmental weeds in Victoria, or in the Victorian Weed Risk Assessments (if you can't find it, double check that it is not under an old or a newer botanical name for the same weed).

Purpose: To assess the risk posed by a weed to biodiversity. The plant may have been either newly detected, or has been known to be present for some time but not assessed previously. **Output:** Recommendation to either delimit (determine the full extent in the field) or monitor. A risk rating score is not given. **Scale:** Local scale such as, for example, a park, forest or reserve. **Where to find them:** The screen process is described in the "Managing weeds: assess the risk guide", and the completed screens are stored on the Spatial, Temporal, Activity Recorder (STAR) attached to site/species related records. **Note:** The scoring system may be also used for new detections of **native** species, for instance native plants that have been introduced from Australian regions in which they are indigenous.

Completing the screen: There is both a desk-top component and a field component to completing this screen. You will need to view the weed in the field.

Species:	**Screen completed by:**
Species location:	**Date of assessment:**

Weed History

Record the number of world regions (*A Global Compendium of Weeds* by Rod Randall is recommended) in which the species of concern has been recorded as an *environmental* weed (i.e. 'E' references only).

Refer to Table 1 (Page 6) in the *Compendium* and locate the relevant reference and location per reference - use this to determine the number of world regions the species of concern has been recorded (e.g. Africa, Australasia (i.e. Australia and New Zealand), Caribbean, Europe, North America, Pacific, South America and Subantarctic).

- There are 60 pages of references in the *Compendium*, so for ease of use it may be worthwhile printing off the reference pages (as double-sided copy) if many assessments are to be undertaken.
- Check to see if the weed occurs under more than one name (i.e. under synonyms).
- Ignore references linked with 'global' locations or lists of 'potential weeds', unless the original source can be checked to determine whether these lists include any actual records of occurrence.

Randall, R. P. (2017) *A Global Compendium of Weeds* (3rd edn). Perth, Western Australia.

https://www.cabi.org/isc/FullTextPDF/2017/20173071957.pdf or

https://www.dpaw.wa.gov.au/images/documents/plants-animals/plants/weeds/Compendium_3rd_Edition_2017.pdf or

https://nla.gov.au/nla.obj-512788350/view

Additional references used can be added at the end of this sheet.

Number of world regions:

Local Performance	
Measures	**Score**
M1 Invasiveness Propagules are structures that can grow into new plants. These are commonly seeds, but also include detachable vegetative structures such as stem segments, bulbils, and aerial tubers. Vegetative reproduction can occur via such detachable structures, but more commonly occurs via joined vegetative structures, such as roots, rhizomes, stolons or creeping stems. The latter contribute to local spread, whereas seeds and detachable vegetative structures can be more easily dispersed, thereby contributing to spread over larger areas. **M1a Evidence of reproduction** *M1a1 Has the plant reproduced in place i.e. locally at this site, by joined vegetative structures (e.g. local spread via roots, rhizomes, stolons or creeping stems)?* Reproduction via detachable vegetative structures (propagules) is considered to be functionally similar to reproduction via seeds and is covered under the next question. Yes = score 1 No = score 0	
M1a2 Has the plant reproduced by seeds or detachable vegetative structures (e.g. stem segments, bulbils, and aerial tubers)? Yes = score 2 No = score 0	
M1b Pre-reproductive period *How long does it take for a new individual to produce seeds or other propagules?* Less than 1 yr = score 3 1 to 2 yrs = score 2 More than 2 yrs = score 1 Default for shrubs and trees = score 1	
M1c Evidence of spread *M1c1 For vegetative spread via structures joined to parent plants:* Spread to less than 1 m = score 0 Spread more than 1 m = score 1	
M1c2 For spread via seed or detached vegetative propagules: For the direction in which plants are detected at the greatest distance, score as follows, where final detection occurs at: Less than 10 m = score 1 10 to 50 m = score 2 More than 50 m = score 3	
Total score for invasiveness	

M2 Impact **M2a Could species *potentially* alter community structure at this site?** Score the answer to this question as 'yes' or 'no', where: Yes = score 5 No = score 0	
M2b Has the plant attained a high level of cover? Locate a dense patch of the infestation and record its cover to answer the question below. This question will be answered as 'yes' or 'no', where 'yes' corresponds to 50% cover over a 2 X 2 m area for species reproducing vegetatively (via structures joined to parent plants), and over a 5 X 5 m area for those reproducing by seed or other propagules. If the plant reproduces by both	

methods, record the cover that has been achieved through vegetative spread. Yes = score 10 No = score 0 If the recommended sample areas (2 X 2 m = 4 m^2 or 5 X 5 m = 25 m^2) are not available, slightly (e.g. 10-20%) smaller areas can be used; otherwise it will be necessary to monitor the infestation for future increases in cover.	
Total score for impact	

Filters	
F1 Time-related filtering Only complete this section (i.e. **F1a**, **F1b** and **F1c**) if the invasiveness OR impact score total is less than 5. The decision made will be to *monitor*, but this section assists in determining the uncertainty associated with this decision. **F1a Residence time** *How long has it been since first detection of the plant?* Less than 1 yr = score 1 1 to 2 yrs = score 2 Between 2 and 5 yrs = score 3 More than 5 yrs = score 4 Default values = 1–2 years for biennial or perennial herbaceous species (includes aquatic plants) and 2–5 years for woody plants, based on the assumption that plants will have required sufficient time to become reproductive prior to formal identification.	
F1b Pre-reproductive (juvenile) period *How long does it take the plant to produce seed or other propagules for the first time?* (see answer to **M1b**) Less than 1 yr = score 1 1 to 2 yrs = score 2 More than 2 yrs = score 3	
F1c Comparing values for individual filters *Is the number for **F1a** (residence time) greater than that for **F1b** (juvenile period)?* Yes (uncertainty = Medium) No (uncertainty = High) High uncertainty where residence time is less than time to reproduction reflects a lack of opportunity to become invasive and cause impact. Further monitoring will be required to assess weed risk properly for plants that reproduce *only* via seed or other propagules.	
Time-related uncertainty High ☐ (Further monitoring required) Medium ☐ (Continue assessment)	
F2 Disturbance filtering *F2a Does the plant occur only in areas that have been recently (i.e. within the past few years) subjected to disturbance or are adjacent to an edge between natural vegetation and another land use?* Yes = score 1 No = score 0	
F2b What is the maximum distance that the plant (including seedlings) occurs from an edge? Less than 10 m = score 3 10 to 20 m = score 2	

More than 20 m = score 1	
F2c Is the plant associated with other species that are commonly considered indicators of disturbance? Such species will generally be annuals and other early colonisers. Common colonisers of edges, whether they occur next to agricultural land or roads and tracks, include Yorkshire Fog (*Holcus lanatus*), Perennial Veldtgrass (*Ehrharta calycina*), Large Quaking-grass (*Briza maxima*), Spear Thistle (*Cirsium vulgare*), Smooth Cat's Ear (*Hypochoeris glabra*), Cape Weed (*Arctotheca calendula*), Kikuyu (*Pennisetum clandestinum*) and Flax-leaved Broom (*Genista linifolia*). Indicators of other types of disturbance are too many and varied to be listed here. If in doubt, answer 'no'. Yes = score 1 No = score 0	
Total score for disturbance	

Decision making

Local Performance	**Disturbance**
Are invasiveness and impact scores both more than 5? Yes ☐ No ☐	Is the disturbance score less than 4? Yes ☐ No ☐

If the answer to the Local Performance question is 'yes' and to the Disturbance question is 'no', *delimitation* should be undertaken.

In most other circumstances the species should be subjected to *monitoring* over time to detect possible changes in invasiveness and/or impacts.

A possible exception to this rule is the situation where the answer to the Local Performance question is 'no', but the species is found in more than two world regions. In this case, additional information relating to potential weed risk gained from online searches may ultimately support a decision to delimit, employing a precautionary approach.

Decision: Delimit □ OR Monitor □

Where the decision is to *delimit*, the associated uncertainty is low, meaning that this decision may be taken with confidence.

For decisions to *monitor*, if the answer to the Local Performance question is 'no', the decision is associated with low uncertainty if there is relatively low evidence of Weed History (i.e. the species is an environmental weed in two or fewer world regions). If there is a high level of Weed History evidence, however, the decision is associated with high uncertainty if the time-related filter is failed and medium uncertainty if the disturbance filter is failed. This combination (i.e. high World History and low Local Performance) captures so-called 'sleeper weeds' and is the most problematic. If practicable, monitoring at yearly intervals is recommended to detect changes in invasiveness and/or impact.

References

List all references used during this risk assessment (add references below):

- Randall, R. P. (2017) A Global Compendium of Weeds (3rd edn) Perth, Western Australia.

Appendix 3 - Completed example of an Environmental weed risk screen score sheet for White-spined Hudson Pear (*Cylindropuntia pallida*) at Ouyen State Forest

Species: *Cylindropuntia pallida*	**Screen completed by:** Bec James
Species location: Ouyen State Forest	**Date of assessment:** 31.8.2015 based on data collected 31.8.2012

Weed History

Record the number of world regions (*A Global Compendium of Weeds* by Rod Randall (2012) is recommended) in which the species of concern has been recorded as an *environmental* weed (i.e. 'E' references only).

Refer to Table 1 (Page 5) in the *Compendium* and locate the relevant reference and location per reference - use this to determine the number of world regions the species of concern has been recorded (e.g. Africa, Australasia (i.e. Australia and New Zealand), Caribbean, Europe, North America, Pacific, South America and Subantarctic).

- There are 60 pages of references in the *Compendium*, so for ease of use it may be worthwhile printing off the reference pages (as double-sided copy) if many assessments are to be undertaken.
- Check to see if the weed occurs under more than one name (i.e. under synonyms).
- Ignore references linked with 'global' locations or lists of 'potential weeds', unless the original source can be checked to determine whether these lists include any actual records of occurrence.

Randall, R. P. (2012) *A Global Compendium of Weeds* (2nd edn). Department of Agriculture and Food, Western Australia. URL: http://www.researchgate.net/publication/235869421_A_Global_Compendium_of_Weeds_Second_Edition

Additional references used can be added at the end of this sheet.

Number of world regions: **0**

C. pallida* not listed as 'E' reference in *Compendium

Local Performance	
Measures	**Score**
M1 Invasiveness Propagules are structures that can grow into new plants. These are commonly seeds, but also include detachable vegetative structures such as stem segments, bulbils, and aerial tubers. Vegetative reproduction can occur via such detachable structures, but more commonly occurs via joined vegetative structures, such as roots, rhizomes, stolons or creeping stems. The latter contribute to local spread, whereas seeds and detachable vegetative structures can be more easily dispersed, thereby contributing to spread over larger areas. **M1a Evidence of reproduction** *M1a1 Has the plant reproduced in place i.e. locally at this site, by joined vegetative structures (e.g. local spread via roots, rhizomes, stolons or creeping stems)?* Reproduction via detachable vegetative structures (propagules) is considered to be functionally similar to reproduction via seeds and is covered under the next question. Yes = score 1 No = score 0	**0**
M1a2 Has the plant reproduced by seeds or detachable vegetative structures (e.g. stem segments, bulbils, and aerial tubers)? Yes = score 2 No = score 0	**2**
M1b Pre-reproductive period *How long does it take for a new individual to produce seeds or other propagules?* Less than 1 yr = score 3 1 to 2 yrs = score 2 More than 2 yrs = score 1 Default for shrubs and trees = score 1	**3**
M1c Evidence of spread *M1c1 For vegetative spread via structures joined to parent plants:* Spread to less than 1 m = score 0 Spread more than 1 m = score 1	**0**
M1c2 For spread via seed or detached vegetative propagules: For the direction in which plants are detected at the greatest distance, score as follows, where final detection occurs at: Less than 10 m = score 1 10 to 50 m = score 2 More than 50 m = score 3	**2**
Total score for invasiveness	**7**

M2 Impact **M2a Could species *potentially* alter community structure at this site?** Score the answer to this question as 'yes' or 'no', where: Yes = score 5 No = score 0	**5**
M2b Has the plant attained a high level of cover? Locate a dense patch of the infestation and record its cover to answer the question below. This question will be answered as 'yes' or 'no', where 'yes' corresponds to 50% cover over a 2 X 2 m area for species reproducing vegetatively (via structures joined to parent plants), and over a 5 X 5 m area for	0

those reproducing by seed or other propagules. If the plant reproduces by both methods, record the cover that has been achieved through vegetative spread. Yes = score 10 No = score 0 If the recommended sample areas (2 X 2 m = 4 m^2 or 5 X 5 m = 25 m^2) are not available, slightly (e.g. 10-20%) smaller areas can be used; otherwise it will be necessary to monitor the infestation for future increases in cover.	
Total score for impact	**5**

Filters	
F1 Time-related filtering Only complete this section (i.e. **F1a**, **F1b** and **F1c**) if the invasiveness OR impact score total is less than 5. The decision made will be to *monitor*, but this section assists in determining the uncertainty associated with this decision. **F1a Residence time** *How long has it been since first detection of the plant?* Less than 1 yr = score 1 1 to 2 yrs = score 2 Between 2 and 5 yrs = score 3 More than 5 yrs = score 4 Default values = 1–2 years for biennial or perennial herbaceous species (includes aquatic plants) and 2–5 years for woody plants, based on the assumption that plants will have required sufficient time to become reproductive prior to formal identification.	
F1b Pre-reproductive (juvenile) period *How long does it take the plant to produce seed or other propagules for the first time? (see answer to **M1b**)* Less than 1 yr = score 1 1 to 2 yrs = score 2 More than 2 yrs = score 3	
F1c Comparing values for individual filters *Is the number for **F1a** (residence time) greater than that for **F1b** (juvenile period)?* Yes (uncertainty = Medium) No (uncertainty = High) High uncertainty where residence time is less than time to reproduction reflects a lack of opportunity to become invasive and cause impact. Further monitoring will be required to assess weed risk properly for plants that reproduce *only* via seed or other propagules.	
Time-related uncertainty High ☐ (Further monitoring required) Medium ☐ (Continue assessment)	
F2 Disturbance filtering *F2a Does the plant occur only in areas that have been recently (i.e. within the past few years) subjected to disturbance or are adjacent to an edge between natural vegetation and another land use?* Yes = score 1 No = score 0	**1**
F2b What is the maximum distance that the plant (including seedlings) occurs from an edge? Less than 10 m = score 3	**3**

10 to 20 m = score 2 More than 20 m = score 1	
F2c Is the plant associated with other species that are commonly considered indicators of disturbance? Such species will generally be annuals and other early colonisers. Common colonisers of edges, whether they occur next to agricultural land or roads and tracks, include Yorkshire Fog (*Holcus lanatus*), Perennial Veldtgrass (*Ehrharta calycina*), Large Quaking-grass (*Briza maxima*), Spear Thistle (*Cirsium vulgare*), Smooth Cat's Ear (*Hypochoeris glabra*), Cape Weed (*Arctotheca calendula*), Kikuyu (*Pennisetum clandestinum*) and Flax-leaved Broom (*Genista linifolia*). Indicators of other types of disturbance are too many and varied to be listed here. If in doubt, answer 'no'. Yes = score 1 No = score 0	**0**
Total score for disturbance	**4**

Decision making

Local Performance	**Disturbance**
Are invasiveness and impact scores both more than 5? Yes ☑ No ☐	Is the disturbance score less than 4? Yes☐ No ☑

If the answer to the Local Performance question is 'yes' and to the Disturbance question is 'no', *delimitation* should be undertaken.

In most other circumstances the species should be subjected to *monitoring* over time to detect possible changes in invasiveness and/or impacts.

A possible exception to this rule is the situation where the answer to the Local Performance question is 'no', but the species is found in more than two world regions. In this case, additional information relating to potential weed risk gained from online searches may ultimately support a decision to delimit, employing a precautionary approach.

Decision: Delimit ☑ OR Monitor ☐

Where the decision is to *delimit*, the associated uncertainty is low, meaning that this decision may be taken with confidence.

For decisions to *monitor*, if the answer to the Local Performance question is 'no', the decision is associated with low uncertainty if there is relatively low evidence of Weed History (i.e. the species is an environmental weed in two or fewer world regions). If there is a high level of Weed History evidence, however, the decision is associated with high uncertainty if the time-related filter is failed and medium uncertainty if the disturbance filter is failed. This combination (i.e. high World History and low Local Performance) captures so-called 'sleeper weeds' and is the most problematic. If practicable, monitoring at yearly intervals is recommended to detect changes in invasiveness and/or impact.

References

List all references used during this risk assessment (add references below):

- Randall, R. P. (2012) *A Global Compendium of Weeds* (2nd edn). Department of Agriculture and Food, Western Australia. URL: http://www.researchgate.net/publication/235869421_A_Global_Compendium_of_Weeds_Second_Edition
- Chinnock, R. J. (2015) *Feral opuntioid cacti in Australia*. The State Herbarium of South Australia. ISBN: 9781922027436.

Appendix 4 - Victorian Weed Risk Assessment

Summary

Purpose: Victorian Weed Risk Assessments (VicWRA) are used to prioritise by ranking and categorising one assessed species against another assessed weed for the State of Victoria.

Also called: Full WRA, WRA.

Output: Five *Word* documents are produced per species containing evidence of impact and invasiveness, a reference list, and present and potential distribution maps. For each species a comparative *pest plant score* is calculated.

Scale: Victoria statewide.

Where to find them: The WRA process is described in a number of documents curated by the Weed and Invertebrate Research Group in Agriculture Victoria (DEDJTR), and the completed assessments are available on Victorian Resources Online (VRO):

http://vro.depi.vic.gov.au/dpi/vro/vrosite.nsf/pages/invasive_plants_common_a

The scores of the Victorian Weed Risk Assessments are summarised in the Victorian environmental weed risk database available at:

https://www.environment.vic.gov.au/invasive-plants-and-animals/weed-risk-ratings

The process: Is described in Weiss and Iaconis (2002).

Who can complete them?: People trained in the completion of WRAs to a suitable standard. They require a basic level of plant biology and ecology knowledge. There are about 22 people trained in Victoria. The process is publicly available so anyone can undertake an assessment.

Strengths: A decision support tool to guide government investment in weed species.

Challenges: Some species have little available information, there is often poor distribution information available, climatic modelling has its limitations, and it is difficult to quantify uncertainty.

Process

The process is designed to be transparent using a standard set of guidelines. A weed species is assessed using 41 questions about its invasiveness, impacts and an additional question on distribution. Evidence from scientific literature is used to answer each question in *Word* templates. Depending on the evidence, weeds are given an intensity rating of low, medium low, medium high, or high for each question. There are criteria that describe each intensity rating. Depending on the source of the evidence, they are also given a confidence rating. If there is no evidence available to answer a question, there are default scores and confidence ratings described.

There is an involved process for determining the present and potential distribution, including climate matching. The distribution estimation process is data intensive and requires expertise to do it properly and the result is not necessarily accurate. The output is two maps: present and potential distribution.

A score calculator in *Excel* is used to convert the categories in the invasiveness, impact and distribution questions into numeric scores. Weightings are automatically calculated and the scores added up. The result is one score called the *pest plant score* that can be compared to the score of other weeds.

The pest plant score ranges from 0 to 1, with zero (0) being of least concern to one (1) being the most threatening. By comparing the score of a weed to the score of other weeds that have been assessed using the same process, it is possible to see how a weed ranks by the potential threat it poses.

Each species has a hard copy registry file in which the documents (five *Word* documents per species) are stored. The information is also loaded onto VRO where it is available to all with internet connectivity and stored in BioWeb. There is one summary Excel spreadsheet that has all the assessed species listed and there are spreadsheets containing the scores curated by the Weed and Invertebrate Research Group in Agriculture Victoria.

The process is described in a number of papers on Victoria's pest plant prioritisation process.

A VicWRA (often referred to as a 'full WRA') can take just under a week to complete at a cost of $3,500 to $4,000 paid for by the requesting agency. This represents an investment of $1.6 Million work to date.

Purpose

Over 650 VicWRAs have been completed by the Weed Sciences group in Agriculture Victoria mainly for the Victorian Noxious Weed Review (review of the declaration status of weeds under the *Catchment and Land Protection Act 1994* conducted between 2004 and 2008) and Victorian Alert Weed assessments (conducted between 2006 and 2010). Other ad-hoc assessments have been completed.

The VicWRAs completed as part of the Victorian Noxious Weed Review have been published in four publicly available reports. These assessments considered impacts, invasiveness and distribution for social, environmental and agricultural/economic values.

The Victorian Alert Weed assessments were aggregated into 5 (or 6) internal reports. These assessments considered only impacts and invasiveness, not distribution.

All VicWRAs are available on VRO (see above).

Appendix 5 – Advisory list of environmental weeds in Victoria

Summary

Purpose: To help people who protect biodiversity values understand the relative risks posed by different invasive plants so they can concentrate efforts on the species that pose the highest risk.

Also called: Vic Advisory List, Weed Advisory List (WAL), Advisory List.

Output: A published document (PDF) containing an explanation and abridged statewide list of environmental weeds with a ranking score for each and grouped according to risk rating (very high, high, moderately high, medium, lower and potential risk) (White *et al*. 2018). The complete list is also available as an Excel spreadsheet for ease of manipulation. The list can be sorted in various ways.

Scale: Victoria-wide with biomes identified. 'Biomes' are groupings of bioregions that are a landscape-scale approach to classifying the environment using a range of attributes such as climate, geomorphology, geology, soils and vegetation. There are 28 bioregions identified within Victoria.

Where to find them: The PDF document containing the abridged list and the Excel spreadsheet with the complete list are available on the Department external website (search for 'early invaders Victoria weeds'), ECM and STAR, https://www.environment.vic.gov.au/invasive-plants-and-animals/weed-risk-ratings

Who can complete them?: The authors or subsequent reviewers following the same process.

Strengths: A good overview of environmental weed risk ratings across the State and it includes early invaders.

Challenges: Resource intensive to review.

Overview

The advisory list of environmental weeds in Victoria (advisory list) is a very useful tool for land managers to help prioritise weed management activities. The advisory list contains at least 1235 environmental weed taxa (species, subspecies, varieties, hybrids) established in native vegetation in Victoria and potential and early invader weeds (White *et al*. 2018). All environmental weeds have been ranked by an objective 'expert system' according to their management urgency. The advisory list is intended to provide 'non-statutory' advice to conservation managers.

The advisory list can be sorted by biomes (groupings of bioregions), common or scientific name or other attributes included in the table.

The 2018 advisory list replaces the five environmental weed advisory lists published (as PDF documents) in 2008 to 2009 covering about 680 species across the 28 bioregions grouped as: aquatic habitats; coastal plains and heathy forests; inland plains; Mallee; and ranges (Adair, Cheal and White 2008, 2009).

The earlier advisory list authors acknowledged that the lists were not designed to adequately recognise the 'very early colonisers or very new arrivals'. Early invaders were included in the 2018 update commissioned by the WESI project.

The weeds were assessed against five attributes by the authors. The species were given a score, ranked and then put in rating categories (very high, high, moderately high, medium, lower and potential risk). Some weeds were unscored.

The scores ranged from 0 to 33.3, with 0 being the lowest risk weeds to 33.3 being the very high risk weeds, i.e. the lower the score, the lower the potential risk.

Managers of public and private land in Victoria can use the advisory list of environmental weeds as a guide to prioritise weed work in their management areas. Some Parks Victoria staff use the advisory list to prioritise funding for on-ground works.

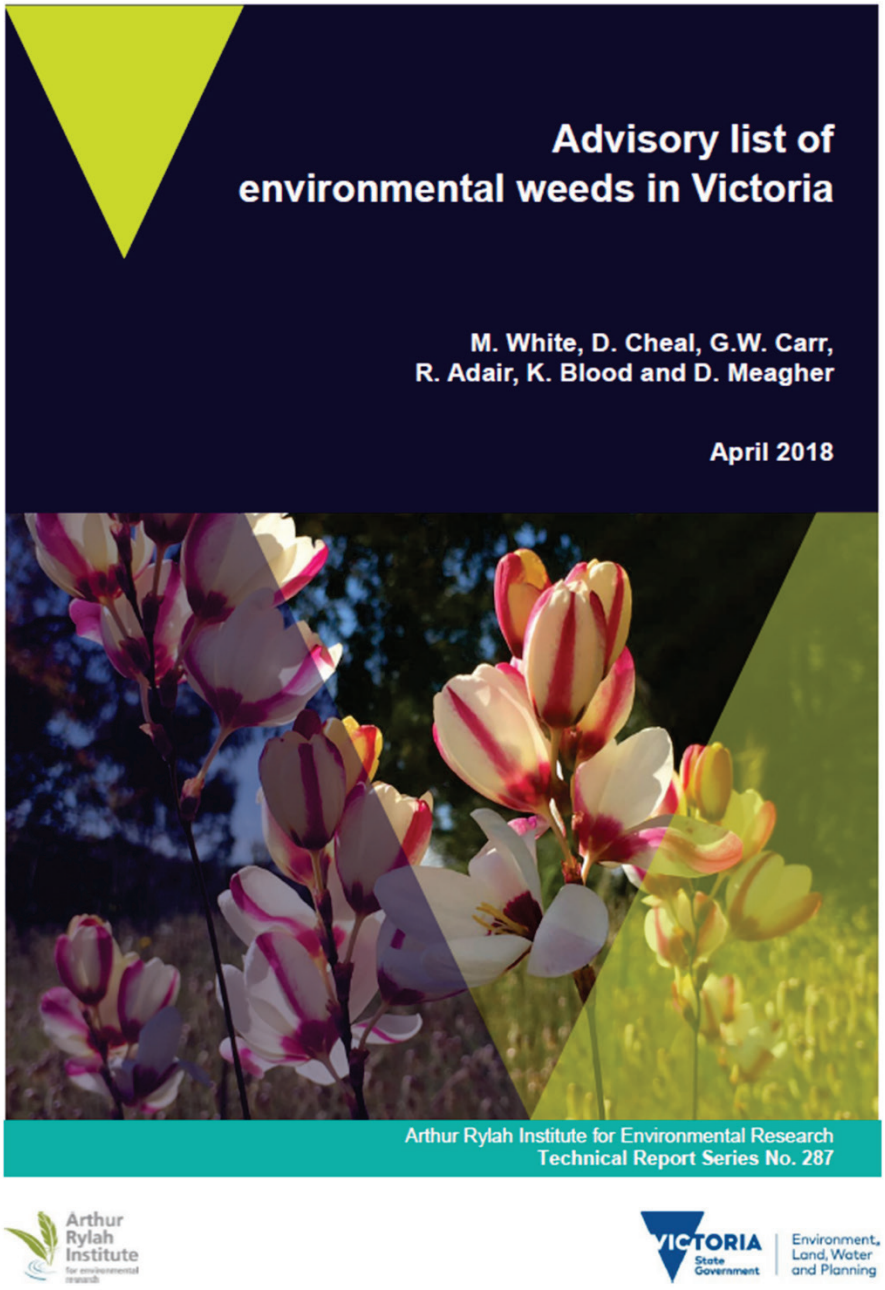

Figure 11 - Cover from the advisory list of environmental weeds in Victoria.

Advisory list of environmental weeds in Victoria (abridged version April 2018)

The following abridged list is a fixed ranking of weed species for Victoria at the date of this publication. This list ranks environmental weeds based on *Risk Ranking Scores* – highest to lowest - and then sorts by scientific name for those species with equivalent scores. The advisory list, with the complete set of annotations and attribute scores, is available online as a searchable and sortable spreadsheet at: https://www.environment.vic.gov.au/invasive-plants-and-animals/weed-risk-ratings (or use the search term 'Victoria weed risk ratings' in your browser).

Scientific Name	Common Name	Family	Weed status in Victoria	Impact on natural systems	Area of potential distribution remaining	Potential for invasion	Rate of dispersal	Range of susceptible habitat types	Risk Ranking Score	Risk Rating
Billardiera fusiformis	Australian Bluebell	Pittosporaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Cotoneaster pannosus	Velvet Cotoneaster	Rosaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Cotoneaster simonsii	Himalayan Cotoneaster	Rosaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Cotoneaster ×watereri	Waterer's Cotoneaster	Rosaceae	Environmental weed	Typically significant	Early stage of invasion	Highly invasive	Rapid	Extensive	33.3	Very high
Disa bracteata	South African Orchid	Orchidaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Hedera helix	English Ivy	Araliaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Lonicera japonica	Japanese Honeysuckle	Caprifoliaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Nassella neesiana	Chilean Needle-grass	Poaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Olea europaea subp. *europaea*	Common Olive	Oleaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Parapholis strigosa	Slender Barb-grass	Poaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Rubus echinatus	Blackberry	Rosaceae	Environmental weed	Typically significant	Early stage of invasion	Highly invasive	Rapid	Medium	33.3	Very high
Rubus vestitus	Blackberry	Rosaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Extensive	33.3	Very high
Asparagus declinatus	Bridal Veil	Asparagaceae	Environmental weed	Typically significant	Early stage of invasion	Highly invasive	Rapid	Medium	33.2	Very high
Asparagus scandens	Asparagus-fern	Asparagaceae	Environmental weed	Typically significant	Extensive potential for further spread	Highly invasive	Rapid	Medium	33.2	Very high

Figure 12 - Extract from the abridged advisory list of environmental weeds in Victoria.

Appendix 6 - Victorian Biosecurity rapid assessment procedure

Summary

Purpose: To rapidly assess weed risks to agricultural and social values in Victoria.

Also called: Rapid assessments.

Output: One to two pages of text (plus attachments) about the potential risks based on experience elsewhere or observations in Victoria. A risk rating is given.

Scale: Victoria statewide.

Where to find them: The procedure is available from Angela Constantine, DEDJTR Agriculture Victoria, and the completed rapid assessments are stored on BioWeb2.

Who can complete them?: Angela Constantine and Zachariah Munakamwe, Biosecurity Officer, Agriculture Victoria.

Strengths: Rapid turnaround, snap shot of published information, indicator if further assessment is required.

Challenges: Not a strong focus on environmental threats, only available to agency staff with approved access.

Overview

Biosecurity and Agriculture Services Branch, Agriculture Victoria DEDJTR have a shorter and cheaper rapid assessment procedure for the whole of the State. Its focus is on agricultural and social, not environmental, values. “A rapid assessment is a quick, yet consistent method for determining whether a species poses a sufficient risk to warrant any further investigation” (Sept 2013). Depending on the findings of the rapid assessment, a full Victorian Weed Risk Assessment may then be warranted. The rapid assessments are stored on Biosecurity’s Bioweb2.

The rapid assessments commenced in 2009 and contain facts and observations. Since April 2013, rapid assessments sometimes include ratings of high, medium or low for potential impacts to agriculture, environment and social values; and for spread potential. To 2018 there are rapid assessments for about 80 weeds (including some groups of weeds). The rapid assessments available on Bioweb2 do not contain a management recommendation or the priority it should be given for the State.

Appendix 7 - Transformer species

Summary

Purpose: To list environmental weeds that can change ecosystems and spatially model places in Victoria susceptible to their invasion.

Also called: Transformer weeds, transformers.

Output: *Excel* spreadsheet of 384 species, and spatial modelling outputs.

Scale: Any scale within Victoria.

Where to find them: Curated by Matt White at Arthur Rylah Institute (ARI), DELWP.

Who can complete them?: Contact Matt White, ARI.

Strengths: Focuses on the environmental weeds having the highest impacts, spatially shows where they can invade in Victoria at any scale, subject to many variables.

Challenges: Having the spatial information available in an understandable format to field practitioners.

Overview

Transformer species are a subset of invasive plants that have the capacity to change the character, condition, form or nature of ecosystems over substantial areas relative to the extent of that ecosystem (Richardson *et al*. 2000).

The Victorian transformer species is a list of 384 species (from c 2011) in an *Excel* spread sheet (A-Z by botanical name). This list has been derived from the Victorian environmental weed advisory lists published in 2008/2009 using the species from the highest ranked categories for impact, and any invasiveness category.

Matt White (ARI) is using this information to spatially model the probability that a place supports transformers i.e. a map that represents the likelihood that a transformer weed has already invaded a location. Variables being included in the modelling that might predict either disturbance or propagule pressure, are distance from unsealed roads, distance from sealed roads, distance from dwellings, internal distance from the edge of a remnant, landuse/landcover etc.

The transformer data is being used for Strategic Management Prospects (SMP) modelling that ranks the potential benefit of undertaking management (addressing the main types of threats) at different places in the landscape. SMP is a next step in the NaturePrint approach.

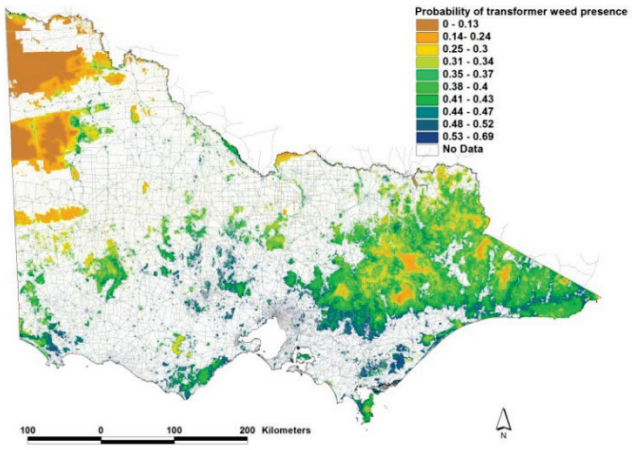

Figure 13 - Map that represents the likelihood that a transformer weed has already invaded a location (Matt White, model is circa mid 2011).

Appendix 8 - Environmental weed risk to vegetation formations

Summary

Purpose: Risk ratings indicate the short to long term threat posed to one or more vegetation formations in Victoria (Carr *et al*. 1992).

Output: A letter code for four risk categories against 576 weed species listed in Victoria.

Scale: Victoria statewide with likely vegetation formations invaded listed.

Where to find them: In *Environmental weed invasions in Victoria* (Carr *et al*. 1992).

Who can complete them?: Authors of *Environmental weed invasions in Victoria*.

Overview

In 1992, a group of three authors, Geoff Carr, Jeff Yugovic and Kim Robinson, published a book called “Environmental weed invasions in Victoria” (Carr *et al*. 1992).

Included in the book is a table of 584 taxa (576 species). The table contains coded information including a risk rating for each weed. The risk ratings used indicates the short to long term threat posed to one or more vegetation formations in Victoria (Carr *et al*. 1992):

V very serious threat to one or more vegetation formations;

S serious threat to one or more vegetation formations;

P potential threat to one or more vegetation formations;

N not a threat (but may have negative visual impact).

There are 15 vegetation formations listed.

Table 8 - Risk ratings for weeds listed.

Risk	Taxa
Very serious	130
Serious	184
Potentially serious	245
Not a threat	25

In some cases, the risk rating is likely to have been underestimated. Further information on distribution, population status and structure, dispersal, rate of invasion and structural role as invaders may result in modifications to the current risk rating. Species may also occur in mixed populations where individually they have little deleterious impact but collectively they have serious consequences (Carr *et al*. 1992).

This publication may be updated in the future by the lead author.

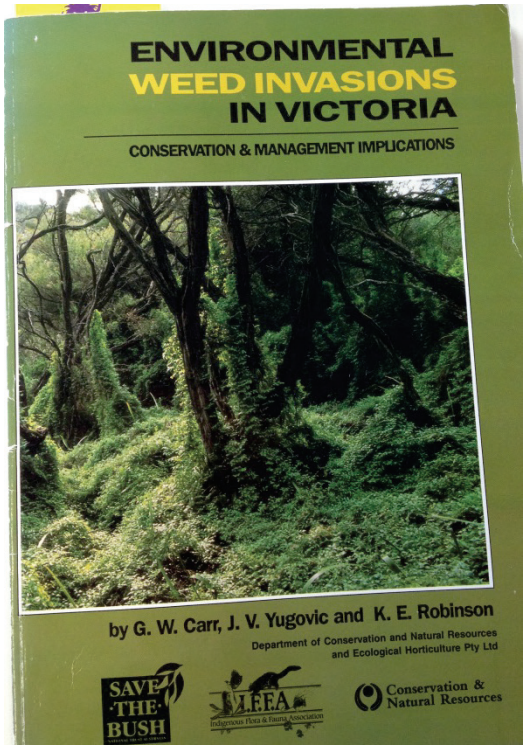

Figure 14 - Cover of Environmental weed invasions in Victoria 1992.

Appendix 9 - Weed data sources

Below is a number of tables summarising information sources on weeds. They are organised by the type of information they contain. The information may be static or dynamic.

Static: the data has been generated at a given point in time and published. To be updated (likely to be infrequently e.g. over more than 12 months between updates if ever), it needs to be done manually.

Dynamic: the data is being added to and updated constantly by other parties.

Table 3 - This table includes weed risk assessment data sources that may contain some analysis or modelling. These could be useful for public land managers who are compiling weed lists and information.

Risk assessment – suggests some analysis or modelling involved	Data description	Custodians or contacts
Advisory list of environmental weeds in Victoria See Appendix 5.	Published pdf document and *Excel* spreadsheet DELWP 2018. Priorities determined by authors. Over 1780 species of which 1235 are environmental weeds. Environmental focus through 5 attributes and at bioregional level. Each weed given a score, ranked and then put in rating categories (very high, high, moderately high, medium, lower and potential risk). Published pdf document used by public land managers including Parks Victoria to determine local weed priorities. Static with occasional updates.	Curated by DELWP ARI (Matt White). PDF and Excel file available on DELWP external website, ECM and STAR.
Species that have undergone a Weed Risk Assessment (WRA) See Appendix 4.	Over 600 species assessed; each weed is assessed against 41 questions, these are given a rating and then a weighted score is generated (pest plant score). Each assessment is accompanied by 'present' and 'potential' distribution maps (except Victorian Alert Weeds). Data sets include: Noxious Weeds Review; Victorian Alert Weeds; and other WRAs done on request. Data used by Victorian Government during review of declaration status of weeds. Static with occasional updates.	Data curated by Agriculture Victoria, DEDJTR, Bundoora. Species assessed available on Victorian Resources Online at http://www.dpi.vic.gov.au/vro and on Bioweb. Summary on DELWP external website.
Victorian environmental weed risk database See Appendices 4 and 5.	The Victorian environmental weed risk database is an *Excel* spreadsheet containing a summary of the Victorian Weed Risk Assessments scores. Static with occasional updates.	Available on DELWP external website, ECM, STAR, and L:\Department Business Share\WESI.
Transformer species dataset See Appendix 7.	384 species (c2011) listed in an Excel spread sheet (A-Z). Used during modelling work by Matt White DELWP. Static.	Data curated by Matt White, ARI, DELWP.
Biosecurity rapid assessment procedure See Appendix 6.	Completed rapid assessments are stored on Bioweb2. Static with occasional updates.	Available through Angela Constantine, Agriculture Services and Biosecurity

Risk assessment – suggests some analysis or modelling involved	Data description	Custodians or contacts
		Operations Branch, Agriculture Victoria, DEDJTR and on Bioweb.
Environmental weed risk screens See Appendix 2.	Completed screens will be available on STAR. Static with occasional updates.	STAR, DELWP and Parks Victoria.
Environmental weed risk to vegetation formations See Appendix 8.	A table of 584 taxa (576 species) in book titled "Environmental weed invasions in Victoria" (Carr *et al*. 1992) with coded information for each weed including a risk rating posed to one or more of 15 vegetation formations in Victoria: very serious, serious, potential, or not a threat. Static.	Carr *et al*. 1992
Post-fire weeds triage manual: Black Saturday Victoria 2009	List of approximately 1560 taxa (A-Z) with assigned weed group depending on response to fire to assist in prioritisation of weed species for funding/management after fire. Used by land managers and owners after bushfire. Static.	Data curated by ARI (Matt White and ex DELWP David Cheal).
NaturePrint	A suite of decision-support products and tools designed to help make choices about what actions to take, and in which places, to protect Victoria's environment and plan for the future. Dynamic.	David Parkes DELWP
Strategic Management Prospects	NaturePrint's Strategic Management Prospects tool is designed to help biodiversity managers consider and compare which actions to do where. To deliver the Biodiversity Plan's goals and targets and to try to prevent more species from becoming threatened, we need our management efforts to achieve the most benefits for the most species. To achieve the most positive change for biodiversity, it is important to choose activities based on the greatest benefit to the most species at the least cost. Dynamic.	David Parkes DELWP

Table 4 - This table includes data sources for specific weed alerts or target lists. These could be useful for public land managers who are compiling weed lists and information.

Specific alert/target list	Data description	Custodians or contacts
National Alert List of Environmental Weeds	List of 28 non-native weeds (A-Z) that have established naturalised populations in the wild. These have also undergone a WRA for Victoria. Plant species that are in the early stages of establishment and have the potential to become a significant threat to biodiversity if they are not managed in Australia. Static.	List available at http://www.environment.gov.au/biodiversity/invasive/weeds/
Weeds of National Significance (WONS)	List of 32 weeds (41 taxa in all) (A-Z). Most of these have also undergone a WRA for Victoria. Weeds already causing significant agricultural, forestry and environmental damage in Australia, based on their invasiveness, potential for spread and environmental, social and economic impacts. Static.	List available at http://www.environment.gov.au/biodiversity/invasive/weeds/ and http://weeds.ala.org.au/WoNS/
National eradication targets	Six species targeted for national eradication, 4 of which are tropical (A-Z). Static.	List available at http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/eradication.html
National agricultural sleeper weeds	17 potential agricultural sleeper weeds that complement the Weeds of National Significance list (A-Z in 4 categories). Static.	http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/sleeper.html
Noxious weeds (*Catchment and Land Protection Act 1994*) of Victoria	Over 120 weeds (A-Z) have been categorised according to declaration status. They may change with proposed Invasive Species Bill. Used during compliance work by DEDJTR Agriculture Victoria. Static with occasional updates.	Data available on DEDJTR Agriculture Victoria external web site.
Weeds in Australia	Information on 399 weed species (A-Z) in Australia includes descriptions, images, origin, distribution, impacts, treatment techniques, status, and references. Static.	http://www.environment.gov.au/biodiversity/invasive/weeds/index.html

Table 5 - This table includes weed distribution data sources. These could be useful for public land managers who are compiling weed lists and information.

Distribution & data recording or viewing through a portal	Data description	Custodians or contacts
Victorian Biodiversity Atlas (VBA)	Web-based information system designed to manage information about native and naturalised species occurring in Victoria. The system will include species attribute information (including origin and conservation status), along with more than six million records of species distribution and abundance, comprising systematic survey data, herbarium and museum records, and general observations. The VBA will replace several existing systems, including the Flora Information System, the Atlas of Victorian Wildlife, the Aquatic Fauna Database and the VROTPop system. Dynamic data.	DELWP https://www.environment.vic.gov.au/biodiversity/victorian-biodiversity-atlas
VICFLORA	An online resource to the plants, fungi and algae of Victoria including weeds. Including early invaders. Dynamic data.	National Herbarium of Victoria https://vicflora.rbg.vic.gov.au/
Illustrated Flora of South-east Australia	Illustrated Flora of South-east Australia packages are easy-to-use Windows or Web-based guides to the plants of South-east Australia. They contain descriptions, photographs, drawings, identification aids and distribution data for virtually all species of vascular plants that live in the wild in this part of the country (6/2/2018 extract from http://www.viridans.com). Formerly called Flora Information System (FIS). Dynamic data.	Viridans Pty Ltd. Data includes DELWP information. Unsure how the data exchanges occur or what agreements are in place. http://www.viridans.com
Australia's Virtual Herbarium (AVH)	Provides access to information obtained from the collections held in Australian herbaria: over six million plant, algae and fungi specimens. The collecting data stored with these specimens provides the most complete picture of the distribution of Australia's flora to date. From this site you can search, map, download and analyse records from the databases of the major herbaria in Australia. Dynamic data.	http://avh.chah.org.au/
Atlas of Living Australia (ALA)	The atlas contains information on all of the known species in Australia, aggregated from a wide range of data providers: museums, herbaria, community groups, government departments, individuals and universities (18/10/2013 modified extract from http://www.ala.org.au/about-the-atlas/) Dynamic data.	http://www.ala.org.au/
Bioweb, Bioweb2	Bioweb is based on the commercial SharePoint platform but has been developed for a variety of uses by DEDJTR Agriculture Victoria Biosecurity staff. This is where information is kept on High Risk Invasive Plants, new and emerging species, rapid assessments, WRAs, Weed Spotters and State prohibited weeds. Dynamic data.	DEDJTR Agriculture Victoria

Table 6 - This table includes weed treatment activity and management data sources. These could be useful for public land managers who are compiling weed lists and information.

Activity/treatment recorder	Data description	Custodians or contacts
Invasive Species Information System (ISIS) (legacy system, data now in MAX on Bioweb)	Biosecurity weed data for State prohibited weeds (declared under the CaLP Act) – see Bioweb2 above.	DEDJTR Agriculture Victoria
Integrated Pest Management System (IPMS) (legacy system)	Biosecurity weed data – see Bioweb above.	DEDJTR Agriculture Victoria
Environmental Information System (EIS)	Parks Victoria weed information. Being migrated to STAR. Dynamic data.	Parks Victoria
eWeed – Otway Eden system for tracking and monitoring treatments and infestations.	Point data only (not polygons). Contains about 10 years of data. Dynamic data.	Parks Victoria Otway Eden
Spatial, Temporal, Activity Recorder (STAR)	STAR captures environmental management activity information once and makes it available for reuse. It stores information on planned and delivered activities to support evidence based decision making, continuous improvement and demonstrate investment effectiveness. Operational and under further development. Will cover assessment (including planning, results, assessment techniques for threat or asset etc.), treatment and engagement. Uses polygons and is web based. It does not perform analysis of outputs. The source data will sit in VBA. Dynamic data.	Virginia Harman is DELWP contact.

Table 7 - This table includes databases and websites that can be useful when completing the environmental weed risk screen score sheet (see Appendix 2). Most of this material is abstracted from the revised National Post-border Weed Risk Management Protocol (in preparation).

Data sources	Data description	Custodians or contacts
Australia's Virtual Herbarium (AVH)	This website maps the recorded locations of plant specimens, including exotic species, held within Australia's national and state herbaria.	http://avh.ala.org.au/
Atlas of Living Australia (ALA)	This website contains a collection of data for Natural History Collections for Australia, including plants. The Atlas maps these records and allows access to each data point. Images are available for some species.	http://www.ala.org.au/
California Invasive Plant Council	Website contains invasive plant inventory, definitions, impacts, completed risk assessments, information, research, distribution/risk maps and useful links.	http://www.cal-ipc.org/
Center for Aquatic and Invasive Plants, University of Florida		http://plants.ifas.ufl.edu
eFLORAS.org	Links to online floras from various world regions, including North America and China. Use the Search facility and mark All Floras so that information is obtained from all the floras covered.	http://www.efloras.org/
Global Invasive Species Database (GISD)	This site focuses on invasive alien species that threaten native biodiversity and covers all taxonomic groups (micro-organisms/animals/plants) in all ecosystems. It includes information supplied or reviewed by expert contributors from around the world on species ecology, distribution, management and impacts, with references and links.	http://www.iucngisd.org/gisd/
Hawaiian Ecosystems At Risk website (HEAR)	This website has a lot of information on a large range of temperate and tropical weeds for Hawaii as well as for South Pacific islands.	http://www.hear.org
Invasive Species Compendium	This website is operated by CABI and contains datasheets, maps, images, abstracts and full text on invasive species of the world.	http://www.cabi.org/isc/
PLANTS database	Set up by the United States Department of Agriculture. This database covers all species naturalised in the United States of America (USA) and often has links to further information.	http://plants.usda.gov/topics.html
Pacific Island Ecosystems at Risk website (PIER)	This website is useful for tropical and sub-tropical species and often gives a great deal of information on species covered. It is regularly updated and frequently contains photographs.	http://www.hear.org/pier/scinames.htm
TROPICOS	One of the world's largest databases of plant information, with detailed nomenclature and references, plus herbarium records from the Americas and other parts of the world.	http://www.tropicos.org
Weeds in Australia	This website has a useful list of weeds, including a National Environmental Alert List. It also has a weed identification tool.	http://www.environment.gov.au/biodiversity/invasive/weeds/

Appendix 10 - Wellbeing, safety and hygiene for field work

Wellbeing and safety

Refer to your agency's Occupational Health and Safety (OH&S) requirements for personal protective equipment and safety requirements. Items that should be considered include:

- first-aid kit and snake bite kit;
- personal protective equipment; and
- satellite phone and emergency position-indicating radio beacon (EPIRB) if in remote locations.

Consider these points when you are planning and conducting field work:

- Avoid sun damage to skin – wear appropriate clothing, broad-brimmed hat, gloves, sunscreen, and sunglasses.
- Avoid field work on days of extreme fire danger.
- Be aware of flood and other emergency and weather warnings for the area and take appropriate precautions.
- Have a safety plan and reporting procedure in place for working remotely (refer to your agency's OH&S guidelines).
- When working near roadsides, park safely and wear high visibility clothing such as a reflective vest.
- Wear gaiters and carry a snake bite kit and know how to use it.
- Wear appropriate protective clothing when handling weeds. Be aware of plants which have:
    - spines or barbs that may have sheaths, toxins or irritants. Avoid stick injuries and treat punctures immediately.
    - sap that can cause skin irritation immediately or after exposure to sunlight.
    - fine hairs that can cause skin irritation and become lodged in clothing.
    - pollen and perfumes that can cause allergic reactions including respiratory irritation and hayfever.
- If working with cacti, carry pliers to remove cacti spines from footwear. Always check the back of boots before crouching down. Some cacti have spines with sheaths that remain in the body when the spine is removed. The "Managing Opuntioid cacti in Australia" manual has a chapter on safety and welfare (Sheehan and Potter 2017).
- Seek prompt medical advice if reactions, injuries or infections occur.

Hygiene

It is very important not to spread weeds, pests, wildlife diseases, soil-borne and plant-borne diseases between and within sites. Examples of things that may spread other than weeds include soil and plant-borne pathogens such as Phytophthora, Myrtle Rust, Chytrid fungus of frogs, and crazy ants. Consider these hygiene points when you are planning and conducting field work and check your agency's hygiene protocols:

- Carry a hygiene cleaning kit with instructions in vehicles, and a sealable container (e.g. plastic bottle with screw-top lid) in which to place loose or seeds removed from clothing for later safe disposal.
- Wear cotton clothing that seeds do not readily adhere to and avoid cuffs on trousers and shorts.

- Wear gaiters over socks and boots.
- Clean footwear and clothing including seeds in laces and socks, and soil on soles before and immediately after a site visit.
- Avoid placing carry bags and packs on weeds that are in seed.
- Regularly check camera bags and clothing pockets for seeds.
- Plastic sample bags can build up static electricity to which weed seeds can readily adhere.
- Avoid driving vehicles into weed infestations and check and clean the vehicle regularly including within the cabin and boot or tray.
- Consider undertaking WeedStop training to maintain suitable vehicle hygiene standards.
- Ensure other staff and contractors conducting field work are following appropriate hygiene standards.
- Be aware that the transportation of plant propagules of declared noxious weeds without a permit is prohibited. If collection of a sample or herbarium specimen is required for identification purposes, contact 136 186 for further advice.
- Companion and conservation working dogs readily pick up and spread weed seeds on their coat and between their toes.
- Consider using a footbath before entering and leaving wetland areas to reduce the risk of spreading Root Rot (*Phytophthora cinnamomi*) or frog disease, Chytrid fungus (*Batrachochytrium dendrobatidis*).

Support

Working with invasive species can be overwhelming at times. Seek help if you are feeling down or overwhelmed. Check in with your local workplace peer support person, OH&S person or contact:

Beyond Blue: www.beyondblue.org.au 1300 224 636

Lifeline Australia: www.lifeline.org.au 13 11 14

Appendix 11 - Further contacts

Contact the WESI project team

The WESI project team can assist with risk ratings and working out what to do next.

Having some information ready when making contact will make it easier for the WESI project team to help you:

- Your name and contact details (email, mobile phone etc.)
- The botanical name of the weed(s) you need the risk rating for
- Where and when the weed was detected (location name, land tenure, directions, and GPS reading)
- Any notes on what it looks like and the situation it is growing in e.g. growing in sand or clay or in a water body
- Observations about how the weed may have got there, what is spreading it and how far it has spread. An estimate of how many plants there are and the area covered
- What are its impacts and what are the biodiversity values under threat?

Have you taken photographs of plant features and landscape that can be emailed? Electronic images can be emailed to the WESI project team to assist with identification (if images are large, only one image should be attached to each email). Alternatively, let WESI know that you have placed images in the WESI folder on the DELWP corporate drive statewide: L:\Department Business Share\WESI early invaders

For assistance with a possible weed at the early stage of invasion contact the WESI project team.

Bianca Gold

bianca.gold@delwp.vic.gov.au

Kate Blood

kate.blood@delwp.vic.gov.au

Phone via the Customer Service Centre 136 186.

The WESI project has a seasonal newsletter “Early invader update” that you can receive for free. Contact us to subscribe.

The project team is active on social media. Search for handle @weedyk8 and hashtags #WESIProj #weedID #invasivespecies

Agency contacts

Victorian Government Customer Service Centre: 136 186 (for DELWP and DEDJTR/DJPR Agriculture Victoria)

https://www.environment.vic.gov.au/

https://economicdevelopment.vic.gov.au/

Parks Victoria: 13 1963

http://parkweb.vic.gov.au/

Glossary and abbreviations

Glossary

Annual - A plant that completes its lifecycle in one year or less. It grows from seed, matures, flowers and produces seed before dying.

Asset-based approach - Involves prioritising control actions for a number of threats, based on the relative value of identified assets that will be protected by the actions. The aim of prioritisation is to maintain the viability of important environmental assets and optimise outcomes for asset protection and management (Victorian Government 2010).

Biennial - A plant that completes its lifecycle in more than one year, but less than two years. It grows from seed, matures, flowers and produces seed before dying.

Biodiversity - The variety of life forms: the different plants, animals and microorganisms, the genes they contain and the ecosystems they form (Victorian Government 2010).

Biodiversity asset - The area (e.g. nature reserve or park) that is being managed to preserve biodiversity values (Panetta 2016).

Biomass - Biological material derived from living or recently living organisms, in this case plants (Panetta 2016).

Biomes - Groupings of bioregions that are a landscape-scale approach to classifying the environment using a range of attributes such as climate, geomorphology, geology, soils and vegetation. There are 28 bioregions identified within Victoria (White *et al*. 2018).

Bioregion - Broad scale mapping unit that captures the patterns and ecological characteristics in the landscape. These units classify the environment using a range of attributes such as climate, geomorphology, geology, soils and vegetation. There are 28 bioregions identified within Victoria.

Bulbil - A small bulb produced on a plant stem above ground that can grow into a new plant. A detachable propagule (Blood and James 2016b).

Containment - The aim of preventing or reducing the spread of invasive species, e.g. by preventing invasions into new areas and eradicating any species that are found outside a defined area or beyond a defined line (Panetta 2016).

Control - To implement actions that reduce the effects of a pest organism where it occurs. For weeds, a wide range of treatment methods are used for control, generally falling into the categories of mechanical, chemical and biological control (Panetta 2016).

Decision making framework - Information organised in such a way to lead the user through a logical step-by-step process to make decisions (Blood and James 2016a).

Delimit, delimiting survey, delimitation - The process of determining the full extent of an invasion. This usually involves intensive surveys of areas in which the species is considered likely to be present (Panetta 2016).

Detectability - The probability of a particular target individual being detected using a particular sampling technique (Hester *et al*. 2010).

Early intervention - The timely action to prevent a small problem becoming a large one.

Early invaders, early weed invaders - These are plants that have naturalised and that have started to spread. Since spread has just begun, such plants are not at all widespread and are generally encountered only by chance, unless specifically targeted by search efforts. Co-ordinated management intervention, i.e. eradication or containment, is at its most feasible for plants at this stage of invasion, owing to their highly restricted distributions (Panetta 2016).

Early stage of invasion - See ‘early invader’.

Ecosystem - An ecosystem consists of a diverse and changing set of living organisms that form a community, interacting with each other and with the physical elements of the environment in which they are found (DSE 2009).

Edge effects - The effects of human-induced disturbance where stands of natural vegetation are located adjacent to a different type of land use (e.g. agricultural land) or are associated with infrastructure such as roads and tracks.

Environmental weed - Exotic or Australian native plant growing beyond its natural range that has, or has the potential to cause, a detrimental effect on natural values (DSE 2009).

Environmental weed risk screen, risk assessment screen - A method designed to identify species that pose the greatest weed risk, based upon measures of (or characteristics related to) invasiveness (the 'likelihood' component of risk) and impact (the 'consequence' component of risk). The screen was developed in 2015 to assess the weed risk posed by a plant that has been either newly detected, or has been known to be present for some time but not assessed previously. Its purpose is to provide a means for identifying the plants that pose the highest threat to biodiversity, particularly on public land at the local scale e.g. national park, conservation reserve, State forest.

Eradication - The elimination of every single individual (including propagules) of a species from a defined area in which recolonisation is unlikely to occur (Panetta 2016).

Extirpation - Denotes local, as opposed to global, elimination of a species (Panetta 2007). For this guide series 'park-scale eradication' is used instead.

Herbaceous - Herb-like, not woody (FloraOnline 2010).

Hygiene - For weed practitioners, hygiene relates to the cleaning of equipment, machinery, vehicles, personal clothing and footwear etc. to avoid spreading weed propagules, pests, wildlife diseases, soil-borne and plant-borne diseases within and between sites (Blood and James 2016a).

Identification - The process of naming a plant, if not instantly from your knowledge, then through a more structured process, either by using a botanical key or other reference. Until a plant identification has been verified through the collection and submission of a specimen to the National Herbarium of Victoria (Herbarium), a proposed or preliminary name can be called a ‘provisional’ identification (Blood and James 2016a).

Impact - The effects that an alien plant species has on native species, supported with quantitative data (e.g. 'the invasion impacted the native species by reducing its density by 70% within 12 months'). However, where weed risk assessment is concerned the term impact is generally employed in the context of whether a weed species has the ability to cause an impact, rather than by describing the actual impact (Downey *et al*. 2010).

Indigenous - Native to the area; not introduced (FloraOnline 2010).

Invasive plants - Naturalised plants that produce reproductive offspring, often in very large numbers, at considerable distances from parent plants (approximate scales: greater than 100 m; under 50 years for plants spreading by seeds and other propagules; greater than 6 m in 3 years for plants spreading by roots, rhizomes, stolons, or creeping stems), and thus have the potential to spread over a considerable area (Richardson *et al*. 2000).

Juvenile period (synonym pre-reproductive period) - The time between when a plant appears as a seedling and when it first produces propagules (Panetta 2016).

Local performance - On-ground evidence of a plant's invasiveness and impact (as opposed to the predictions of invasiveness and impact that are generated through desktop weed risk assessment procedures) (Panetta 2016).

Monitor - To observe and check the local performance of a plant species over a period of time, in order to detect increases in invasiveness and impact should these occur. If practicable, monitoring at yearly intervals is recommended (Panetta 2016).

Monoculture - Growing a single crop species.

Native species - Species that is believed to have occurred in a specified part of Australia prior to European settlement (Victorian Government 2010).

Naturalised plants - Non-indigenous species that sustain self-replacing populations for several life cycles without direct intervention by people, or despite human intervention. Naturalised species are not necessarily invasive, that is they have not (yet) spread any significant distance (Panetta 2016).

Noxious weed - In Victoria, a weed declared under the *Catchment and Land Protection Act 1994*, and there are four categories of noxious weed.

Pathogen - An infectious agent such as a virus, bacterium, prion, fungus, viroid, or parasite that causes disease in its host (Reference viewed online 3/9/2015: https://en.wikipedia.org/wiki/Pathogen).

Perennial - A plant whose life-span is longer than two growing seasons i.e. longer than an annual or biennial.

Pest plant score - A single weighted score generated when a weed is assessed against 41 questions in the Victorian Weed Risk Assessment process. This score can be compared to other weeds that have been assessed using the same process.

Prevention - Is the act of preventing, to keep from occurring (Delbridge *et al*. 1998).

Prioritisation tool - See 'Victorian environmental weed risk database'.

Probability - The likelihood that something will occur.

Propagule pressure - A composite measure of the number of individuals that are released or escape into a region to which they are not native. It incorporates estimates of the absolute number of individuals involved in any one release/escape event (propagule size) and the number of discrete such events (propagule number) (Blackburn *et al*. 2014).

Propagule - An independent part of a plant (i.e. a seed or other vegetative structure) that is capable of being dispersed and growing into a new plant (Panetta 2016).

Public land - Land set aside for the use and benefit of the community/public e.g. State forest, national park, public park.

Residence time - The period for which a species has occurred locally (Panetta 2016).

Rhizome - An underground stem, usually growing horizontally (FloraOnline 2010). A rhizome is an example of a joined vegetative propagule.

Risk - The chance of something happening that will have an impact on objectives. NOTE: The level of risk (e.g. high, medium or low) is defined by the particular method being used. Estimating the level of risk requires an objective, evidence-based consideration of the likelihood and consequences of a particular set of circumstances (Victorian Government 2010).

Risk ranking score - Rankable scores (between 0 and 33.3) used during the development of the advisory list of environmental weeds in Victoria to indicate level of risk. Scores were grouped into six risk rating categories (very high, high, moderately high, medium, lower and potential risk).

Risk rating - A generic term used to provide, in this case, an indication of the level of threat posed by a weed in Victoria.

Search, searching - The act of looking for something.

Site - The boundary of the area of interest for the search, survey or treatment within the broader reserve, State forest, or national park etc. It may be defined by vegetation communities, land type most susceptible to invasion, roads or river boundaries that divide the land parcel into more manageable areas (Sheehan *et al*. 2016).

Sleeper weeds - Weed populations where there is an identified mechanism preventing rapid population growth or spread. This is problematic, since often the mechanisms are not identifiable until after the weed 'wakens' and, as such, the term is of little practical value (Panetta 2016).

Stolon - A stem that is usually growing horizontally above the ground, roots forming at the nodes and a new plant forming at the tip. Stolons are a joined vegetative structure propagule.

Synonym - One of two or more names that apply to the same, in this case, plant.

Transformer weeds, transformer species, ecosystem transformers - A subset of invasive plants that change the character, condition, form or nature of a natural ecosystem over a substantial area (Richardson *et al*. 2000). These plants, comprising perhaps in the order of 10% of invasive species, have profound effects on biodiversity and should be prioritised for delimitation.

Treatment - Is a technique applied to a weed to kill or reduce the vigour of the weed and/or its propagules.

Tuber - Usually an underground (but sometimes aerial) storage organ formed by the swelling of a stem (FloraOnline 2010). A vegetative propagule.

Vegetative structures, joined or detachable - Propagules are detachable structures that can grow into new plants. These are commonly seeds, but also include detachable vegetative structures such as stem segments, bulbils, and aerial tubers. Vegetative reproduction can occur via such detachable structures, but more commonly occurs via connected or joined vegetative structures, such as roots, rhizomes, stolons or creeping stems. The latter contribute to local spread, whereas seeds and detachable vegetative structures can be dispersed, thereby contributing to spread over larger areas (Panetta 2016).

Victorian environmental weed risk database - The Victorian environmental weed risk database is an *Excel* spreadsheet that contains a summary of the scores from the Victorian Weed Risk Assessments.

Weed - Plants (not necessarily alien) that grow in sites where they are not wanted and which usually have detectable economic or environmental effects (synonyms: plant pests, harmful species, problem plants) (Richardson *et al*. 2000).

Weed history - Evidence that a species has been recorded as a weed previously, either in Australia or elsewhere in the world. Weed history is regarded as one of the most reliable predictors of behaviour as a weed when a plant is introduced to a new area or region (Panetta 2016).

Weed Risk Assessment - An evidence-based process estimating the relative weed risk of plant species, based on their biological characteristics, impacts on agriculture, the environment and human health, and the ratio of the species' present and potential distribution (Victorian Government 2010).

Weed risk matrix - A matrix that brings together Weed History and Local Performance to recommend either to delimit the species (as a precursor to further determination of eradication feasibility) or to monitor it in the future to detect changes in its invasiveness and/or impact, should these occur.

Weeds at the early stage of invasion - See 'early invaders'.

Woody weeds - Plants containing thickened stems, including trees, shrubs, some vines and creepers.

Abbreviations

ALA	Atlas of Living Australia
app	application
ARI	Arthur Rylah Institute
AVH	Australia's Virtual Herbarium
CLM	Crown Land Manager
CSC	Customer Service Centre
DEDJTR	Department of Economic Development, Jobs, Transport and Resources (to be replaced by DJPR on 1 January 2019)
DELWP	Department of Environment, Land, Water and Planning
DJPR	Department of Jobs, Precincts and Regions (to replace DEDJTR 1 January 2019)
DMF	decision making framework
ECM	Enterprise Content Management
Ecodev	URL abbreviation for DEDJTR
EIS	Environmental Information System
EPIRB	Emergency Position Indicating Radio Beacon
et al.	et alia
FAR	Further Assessment Required
FIS	Flora Information System
GISD	Global Invasive Species Database
GPS	Global Positioning System
HEAR	Hawaiian Ecosystems at Risk project
id, ID	identification
IPMS	Integrated Pest Management System
ISIS	Invasive Species Information System
OH&S, OHS	Occupational Health and Safety
pdf	Portable Document Format
PIER	Pacific Island Ecosystems at Risk
SMP	Strategic Management Prospects map
sp. (singular)	species
spp. (plural)	species
STAR	Spatial, Temporal, Activity Recorder
syn.	synonym
URL	Uniform Resource Locator
VBA	Victorian Biodiversity Atlas
VRO	Victorian Resources Online
WAL	weed advisory list, Victorian advisory lists
WESI Project	Weeds at the Early Stage of Invasion Project
WONS	Weed of National Significance

List of figures and tables

Table 5 - This table includes weed distribution data sources. These could be useful for public land managers who are compiling weed lists and information.

Table 6 - This table includes weed treatment activity and management data sources. These could be useful for public land managers who are compiling weed lists and information.

Table 7 - This table includes databases and websites that can be useful when completing the environmental weed risk screen score sheet (see Appendix 2). Most of this material is abstracted from the revised National Post-border Weed Risk Management Protocol (in preparation).

Notes:

Notes:

www.environment.vic.gov.au/invasive-plants-and-animals/early-invaders