

Victoria's pest plant prioritisation process

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Summary In order to make informed decisions about the best way to control weeds on public and agricultural land it is necessary that the relative importance and potential impact of each weed be determined prior to the allocation of priority works or funding. It is essential that the importance of individual weeds in our environments be understood otherwise the decisions to control them cannot be correctly made. Decisions based on limited factual data and emotional reactions will almost certainly result in unnecessary expenditure of resources and damage to the environment through inappropriate use of control measures.

Victoria has developed a risk assessment process that can work independently or utilises a GIS based system to determine resource conditions and then the risk or threat that weeds pose to these values.

Keywords Weed risk assessment, prioritisation, Decision Support System, analytical hierarchical process.

INTRODUCTION

Weed risk assessment (WRA) has predominantly concentrated on the biological properties of a weed that make it invasive. However the invasive component of a weed is only one component of a WRA. If we want to determine or prioritise weeds an assessment must take into account the impact of the weed on social, environmental and agricultural values (or resource conditions). As these values change depending upon the land managers involved, the scale of the assessment (national, state, catchment or local level) has to be adaptable to account for these differences.

The three major components in predicting weed status are:

1. Assessing the plant's invasiveness,
2. Its current and potential distribution and
3. Impacts of the plant on land use and ecosystems.

The decision making process may also include;

- The value of threatened ecosystems and
- The feasibility of successful control.

Victoria has developed a risk assessment process that can work independently or utilises a GIS based system to determine resource conditions and then the risk or threat that weeds pose to these values. This is a paradigm shift in thinking. Rather than looking at the weed and its biological attributes it focuses on the threat that it has on resources.

This Decision Support System (DSS) is an Expert System relying on multi-criteria analysis/analytical hierarchical process (AHP) that enables complex issues to be broken down into a set of related criteria. The AHP is a method that assists with decisions about priorities using qualitative and/or quantitative information. AHP facilitates effective decisions on complex issues by simplifying and expediting the intuitive decision making process.

Basically the AHP is a method of breaking down a complex unstructured situation into its component parts; arranging these parts into a hierarchical order; assigning numerical values to subjective judgements on the relative importance of each variable; and synthesising the judgements to determine which variables have the highest priority and should be acted upon to influence the outcome of the situation. AHP also provides an effective structure for group decision making by imposing a discipline on the group's thought processes.

Because there is a dearth of specific information on land/resource value and the impact of any particular weed on social, environment and agriculture resources, there is a need for a methodology to mix both qualitative and quantitative information. The DSS allows for this integration.

Potential distribution is a major factor in comparing the threats posed by weed species (Panetta and Dodd 1987). The greater the potential distribution of a weed species, the greater the potential impact and management costs. Knowledge of potential distribution is also important for devising management programs. Landholders can be alerted to the risk of weed invasion and measures can be enforced to prevent the introduction of weed propagules into such areas. Low priority can be given to areas where the weed might fail to persist, or be of little economic importance (Panetta and Dodd 1995).

This Victorian Pest Plant Prioritisation process is a system that allows for a visible and documented weighting to be applied to more important criteria or resources to indicate their importance.

MATERIALS AND METHODS

The AHP, developed by Dr. Saaty, is a method that assists with decisions about priorities using qualitative and/or quantitative information. AHP facilitates

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AHP also provides an effective structure for group decision making. This is generally done either based on already documented scientific information or in workshop sessions with experts.

The Catchment Decision Assistant[®] (CDA) is a software program developed to assist users to prioritise issues, projects or policies in a structured decision making process. It uses AHP for structuring a problem into a hierarchy of criteria, then systematically rating and weighting the relative importance of each criterion as it contributes to the issue, project or policy.

A summary of the steps as described by Saaty (1995) and their modification for application to this case study is shown below.

1. Definition of the issue(s) – problems and/or opportunities.
2. Formation of ‘core’ technical support group.
3. Identification of the focus.
4. Constructing the hierarchy.
5. Where necessary, break down the primary criteria into secondary/tertiary subcriteria.
6. Group agreement on the decision tree.
7. Weight the criteria – using the CDA to generate the weighting of the criteria at each level using a process of pair-wise comparisons. The CDA will check for consistency of the evaluation of the weighting and, if inconsistent, will give the option of reiteration of this step.
8. Develop and apply the intensity ratings for each of the specified regionally controlled weeds.
9. CDA generates an Excel spreadsheet into which users can enter the intensity ratings against each lowest level criterion. The spreadsheet automatically calculates weighted score and final AHP rankings.

Potential distribution can be determined using climate, land-use and vegetation mapping. The climatic requirements of a plant can be determined using climatic data from international and national occurrences of the

plant. Similarly, the susceptibility of particular land-uses, vegetation types, soil types, and watercourses can be determined from previous and overseas records.

RESULTS

Invasive potential Two workshops in June 1998 decided on a set of criteria to assess the biological properties of a plant to indicate its potential to be an invasive weed. The main criteria and groups are shown below.

Criteria to assess potential as an invasive weed.

Establishment

- Germination requirements?
- Establishment requirement?
- How much disturbance required?

Growth/Competitive ability

- Life form?
- Allelopathic properties?
- Tolerates herbivory pressure?
- Normal growth rate?
- Stress tolerance?

Reproduction

- Reproductive system?
- Number of propagules produced?
- Seed longevity?
- Reproductive period?
- Time to reach reproductive maturity?

Dispersal

- Number of mechanisms?
- How far do propagules disperse?

Weightings within groups (e.g. the five criteria within the reproduction group) were decided using pairwise comparisons to determine which criterion was more important and by how much (weakly, strongly, demonstrated, or absolute). The same process is used for weighting the four groups (Establishment, Growth/Competitive ability, Reproduction and Dispersal).

Intensity ratings, or definitions of what constitutes High (H), Medium (M), Low (L), etc., have been developed for the criteria. These ensure that consistency across assessors is achieved. An example of the Intensity rating for the Reproductive system of the plant is shown below.

- H = Both vegetative and sexual reproduction
- MH = Vegetative reproduction
- ML = Sexual (self and cross pollination)
- L = Sexual but either self OR cross pollination

Each criterion is rated on a common scale (e.g. 0 to 1). The final ranking is then calculated by multiplying the criteria weights by the criteria ratings for each weed. Finally, the invasiveness score for a weed is calculated by combining the criteria weightings and ratings as follows:

Invasiveness Score = $\sum ((\text{Criteria Group Weighting} \times \text{Criteria Weighting}) \times \text{Criteria Rating})$

The closer the final score is to 1, the more invasive the plant is. Because all plants have to have some invasive potential (otherwise they could not spread and would become extinct) some 'non' invasive plants have been assessed. They scored generally between 0.25 and 0.45. The full methodology, criteria, intensity weightings and scores have been published for 43 of Victoria's priority noxious weeds (Weiss 1999).

At present 202 plant species have been assessed for their invasive potential, and have been ranked as very highly, highly, moderately and weakly invasive. Some of the weeds that were scored as very highly invasive are also Weeds of National Significance (WONS), e.g. some willows, blackberry, alligator weed and bridal creeper.

Present and potential distribution Figures 1 and 2 indicate the present and predicted potential distribution of Serrated tussock (*Nassella trichotoma* (Nees) Hack. ex Arech.) in Victoria. Nearly all of the plants assessed for invasiveness have also had their predicted potential distribution produced. Some of the maps are available on the web on NRE's Victorian Resources Online at www.nre.vic.gov.au/web/root/Domino/vro/vrosite.nsf/pages/lwm_pest_plants.

Impact The primary criterion for determining how important or high-priority a weed may be is its impact on social, environmental and economic values. This section of the pest assessment process is still being developed at a park, regional, catchment and state wide level. Land managers responsible for their region will be asked to determine the social, environmental and economic values of their land using the AHP process

outlined above. Weeds will then be assessed on the basis of their level (H, MH, M, ML, L) of threat to these prioritised and weighted values.

DISCUSSION

Pest Plant Prioritisation is a complex issue and is still in its infancy. Many organisations in Australia, New Zealand and in the USA are developing prioritisation processes. The WONS process (Thorp and Lynch 2001) enabled weeds to be prioritised at a national level, however there is a need for more detailed prioritisation processes at a state, regional or park level. Western Australia (Randall 2000) and South Australia (Virtue 2000) both have a process that land managers can use to identify priority weeds but neither presently allows land managers to value their social, environmental and agricultural values differently.

The AHP process allows for consultation with land managers to allow them to determine what land values are important to them and by how much. Weeds then can be assessed as threats against these values.

A powerful weapon against weed invasions is early intervention. Early intervention can significantly reduce the social cost of weed invasions and the chance of eradication (Groves 1992). In the assessment process this is determined by comparing the present and potential distribution. In the past, priority has often been given to projects where a clear weed problem already exists. Areas where early intervention is urgently required generally go unfunded or are ranked as being of low priority until weed infestations become critical, by which time action is often too late. A much higher weighting should thus be given to small infestations that have the potential to expand greatly.

At a recent post-entry weed risk assessment workshop held in Canberra in February 2002, risk

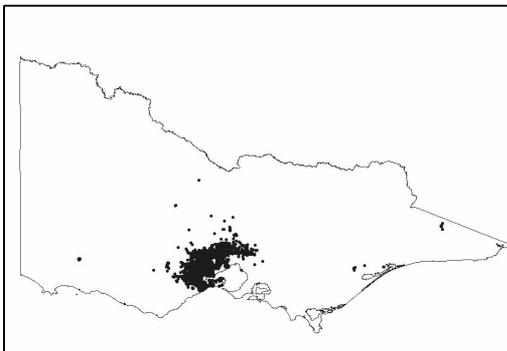


Figure 1. Present distribution of serrated tussock in Victoria (Source, DNRE's Integrated Pest Management System).

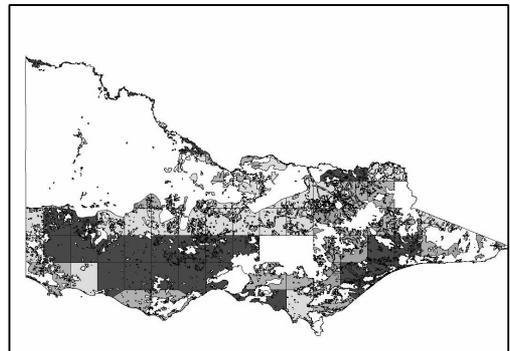


Figure 2. Predicted potential distribution of serrated tussock in Victoria. The darker the shading the more likely the establishment of the weed.

assessors (or plant profilers) from all state and territories aimed to develop a uniform set of criteria for weed prioritisation. Features of the Victorian, South Australian and Western Australian assessment criteria were included in the preliminary draft and will be reviewed and refined.

Victoria is in the process of rolling out its pest plant prioritisation process at a Park, regional catchment and state level over the coming year. It will ensure that the national criteria are included and weighted in its state assessment process.

The economic assessment process outlined by Weiss *et al.* (2002) is a second tier of this prioritisation process and allows for scenario building of different control strategies and the return on government investment in weed control.

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