

## Using Weed Risk Management assessments to inform on-ground action for new and emerging environmental weeds in New South Wales

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**Summary** Weed management goals should be appropriate to the stage of invasion, e.g. eradication is suitable for small incursions and not widespread weeds. Once naturalised, three overarching management strategies exist for weeds: eradication; containment; and/or asset protection. These can be used singly or in conjunction, depending on the scale of invasion. Weed risk assessments (WRAs) are commonly used for preventative or quarantine management (i.e. pre-border to prevent entry). When combined with assessments of the feasibility of control as part of a Weed Risk Management (WRM) system, WRA results can be used to develop appropriate management goals for weeds post entry, e.g. they can be used to prioritise management to eradicate weeds or prevent spread at a range of scales. This is often part of a systematic approach for weeds that may be subject to containment or asset protection efforts elsewhere.

Weed Risk Management assessments are undertaken at a pre-determined scale and land use. They require collation of biological, ecological and management information about the weed being assessed and the current and potential habitats invaded. We performed state-level WRM assessments for 146 potential weeds of conservation lands within New South Wales. The results were used to prioritise management of these weeds as part of overall regional weed management plans. This paper outlines the process used to determine which new and emerging environmental weeds were of the highest risk and most feasible to control. An example of ongoing prioritisation and resulting management is outlined as are the most significant limitations encountered. Despite these, we remain confident that management of the highest-risk and most feasibly controlled weeds can be prioritised and managed.

**Keywords** Post border, weed management goal, regional pest management strategies.

### INTRODUCTION

Plant invasions pose a major threat to New South Wales (NSW) biodiversity (Coutts-Smith and Downey 2006). Downey *et al.* (2010) suggest 1665 non-native plants species have naturalised in NSW, yet only a relatively small proportion of these are recognised as major weeds due to their current or potential future impact.

A key biosecurity principle is that management be undertaken and investment allocated according to cost-effective, science-based and risk-management approaches. For example, the NSW Biosecurity Strategy suggests that a high economic return on investment is achieved through preventing the entry of exotic threats, followed by early intervention and eradication if exotic plants establish, as opposed to investing in the management of widespread weeds (NSW Government 2013). However, the full environmental and social costs of environmental widespread weeds are not accounted for in such economic calculations. Strategic opportunities do and should continue to exist for management of widespread weeds (see Hamilton and Turner 2014 on the evaluation of the Bitou Bush Threat Abatement Plan). Concomitant effort should be maintained to minimise the threat and spread of new and emerging weeds.

Once naturalised, three overarching management strategies exist for weeds: eradication; containment; and/or asset protection (NSW DPI 2008). These strategies can be used singly or in conjunction, depending on the scale of invasion. While weed risk assessments (WRAs) are commonly used for preventative or quarantine management (i.e. pre-border to prevent entry), when combined with assessments of the feasibility of control as part of a Weed Risk Management (WRM) system, WRA results can be used to develop appropriate management goals for weeds post entry, e.g. eradication or spread prevention as part of a systematic approach for weeds that may be subject to asset protection efforts elsewhere (Hamilton and Turner 2014).

The National Post-Border Weed Risk Management Protocol is based on current best practice in weed management science, in combination with the principles of two Australian/New Zealand Standards (Risk management and Environmental risk management) (Anon. 2006). Risk management is an essential element of good corporate governance, providing a transparent, scientifically-based assessment. Post border WRM systems have been developed and used over the past 15 years to make informed judgments on where to spend finite resources on weed management. Consistent with this protocol, the New South Wales Weed Risk Management system was developed in consultation with various stakeholders across NSW (Johnson 2009a) and now provides a standard by which to assess post-border plant incursions in the state (Johnson 2009b). Such post-border WRM assessments are undertaken at a pre-determined scale and land use. Information on the invasiveness, impacts, potential and current distribution, control costs and persistence are used to rank the species' risk and feasibility of control. In this way, the highest-risk and most feasibly controlled weeds can be prioritised and managed first.

#### RISK OF NEW AND EMERGING ENVIRONMENTAL WEEDS

For asset protection in NSW, OEH and DPI developed a strategy to manage widespread weeds to protect biological assets across the state – the Biodiversity Priorities for Widespread Weeds (BPWW) (NSW DPI and OEH 2011). That strategy highlighted the need for a similar systematic approach to the prioritisation of new and emerging weeds. Accordingly, OEH and DPI embarked on a project to determine the highest priority new and emerging environmental weeds by assessing their weed risk and feasibility of control.

A list of 439 weed species thought to be new or emerging threats in environmental areas was assembled. This was compiled from sources such as: the noxious weeds list, regional weed strategies, Weeds of National Significance outlier and containment priorities, information compiled during development of the BPWW, and national lists of new and emerging weeds. The list of 439 weeds was culled to 218 species, to remove weed species that were already widespread in NSW and species not extant in NSW.

Using the WRM system, assessments of individual weed species were completed at the state level for conservation areas in NSW. Sufficient information was available to complete assessments for 146 of the 218 species. These WRM assessments allowed the categorisation of the 146 species into management categories, for example 'eradication', 'contain spread',

'manage sites' etc. Thirty-six species were found to pose a very high risk and were assigned to the 'eradication' and 'destroy infestations' categories (the highest categories for new and emerging weeds). Twenty four of these weeds are already listed as noxious under the New South Wales *Noxious Weeds Act 1993*; these include boneseed (*Chrysanthemoides monilifera* subsp. *monilifera* (DC.) Norl.), miconia (*Miconia calvescens* DC.) and orange hawkweed (*Hieracium aurantiacum* L.). Other species in the highest categories not currently listed as noxious include carrion flower (*Orbea variegata* (L.) Haw.) and *Leucaena leucocephala* (Lam.) de Wit.

#### ON-GROUND APPLICATION

The results of this project are assisting with priority setting to ensure that the highest-risk and most feasibly controlled weeds are managed first. Results have been used to update weed program priorities in National Parks and Wildlife Service Regional Pest Management Strategies (RPMS). For example, an infestation of carrion flower (*O. variegata*) was discovered in 2010 in Pilliga National Park. A WRM assessment was performed by NPWS to ascertain the potential risk and priority for management. This assessment confirmed that carrion flower was a 'very high risk' weed, and the management goal for NSW should be 'eradication'. As such, a 'critical' priority for management was subsequently assigned to the program in the relevant RPMS. This weed has since been the subject of NPWS herbicide trials (Hamilton *et al.* 2013) and for this reason and the WRM assessment result, efforts to raise public awareness of this weed have followed (e.g. Hamilton *et al.* 2013). Unsurprisingly, due to greater awareness amongst land managers, greater knowledge of its distribution has become available (three further infestations were discovered in western NSW), possibly necessitating a need to re-assess the species. This may be the case for a number of 'new' weeds. Once such weeds have been identified and assessed as high priority, there may be a need to raise awareness to ascertain the full distribution, then to re-assess.

In NSW, species are systemically re-evaluated by DPI to document changes in their status and conclusions are amended when necessary (e.g. during review of Weed Control Orders under the *Noxious Weeds Act 1993*), but a more formalised approach may be required.

#### LIMITATIONS

**Lack of information** Notwithstanding the benefits of our project and the WRM system, there are certain limitations with using the system. These largely relate

to lack of information, in particular the need for more information such as knowledge of weed ecology, biology and distribution.

Of the 218 species assessment was attempted for, 72 lacked sufficient data to complete an assessment. In many cases this was due to a lack of biological information. In a similar post-border project to categorise environmental weeds in California, Randall *et al.* (2001) found that for most of the 100 species they considered, reliable quantitative information on the impacts and abundance was unavailable, so qualitative observations were often used. Though later, Randall *et al.* (2008) detail an assessment protocol for the United States of America (invasive plants that impact biodiversity) and suggested that much of the information necessary to complete assessments was increasingly readily available.

With the observed decline in weed research structures and funding, highlighted most recently in the Natural Resources Commission (NRC) review of weed management in NSW (NRC draft report 2013), it is unlikely the States or Commonwealth Governments currently have the necessary research capacity to fully carry out research to determine such information. Therefore, where a species poses a high risk and is at the early stages of invasion, but required information to complete an assessment is unavailable, then the risk that such species will not be managed in a timely manner is high. A permitted-list approach to the sale and interstate movement of potentially invasive plants (Csurhes *et al.* 2006), including banning those with insufficient information to assess, will help this situation. Having said that, it is clear that research capacity needs to be maintained or increased.

If new data becomes available WRM assessments can be revised. All completed and partially completed WRM assessments will soon be available to the public in an online database that is currently being developed by DPI (Auld and Johnson 2014). Information sources such as the Weed Futures website (<http://www.weed-futures.net>) provide potential distribution maps useful for WRM assessments and therefore assessments can be re-evaluated with such data.

**Spatial scale considerations** WRM assessments can be performed at multiple spatial scales; for this project assessments were performed at a State level. At this State scale, the recommended management from the WRM system may be relatively simple, e.g. eradicate from the State. State level assessments do not represent the nuances present at finer scales however, i.e. at regional or local levels. For this reason, regional assessments are probably more appropriate for weeds that have established widely in some areas but not in

others, such that the goal then is to prevent spread. There are a number of weeds that could be managed for containment purposes in NSW, such as ox-eye daisy (*Leucanthemum vulgare* Lam.), sea spurge (*Euphorbia paralias* L.), flax-leaf broom (*Genista linifolia* L.) and climbing asparagus fern (*Asparagus plumosus* Baker). These weeds would benefit from regional assessments across their current and potential ranges. Regional scale assessments reflect more local priorities, for example a weed might be a 'monitor and protect priority sites' priority at a State level but a 'contain spread' priority in an area where it is likely to spread into, or an 'eradication' priority where outlying populations exist.

**Land use considerations** Under the NSW WRM system, assessments are undertaken at a pre-determined scale (state) and land use (environmental areas). In our project, a list of plant species were identified in the 'eradication' or 'destroy infestation' categories. This included species that only have isolated infestations in environmental areas, being the land use used in the assessments. However, some of these species are quite widespread in other land uses such as gardens, street plantings, or are commercially grown (e.g. agapanthus (*Agapanthus praecox* Willd.), European olive (*Olea europaea* L. subsp. *europaea*), and broad-leaf pepper tree (*Schinus terebinthifolius* Raddi). The eradication of such species in environmental areas of NSW may not have a high likelihood of success due to reinvasion from such land uses. Management of these species in conservation areas should still be a priority however, in combination with efforts to make the broader community aware of their invasive capacity and impacts in order to encourage their removal.

## CONCLUSION

Post-border WRM assessments are a useful tool to assist in priority setting. This OEH and DPI project has clarified the new and emerging weed priorities for conservation lands in NSW and, where applicable, NPWS management priorities have changed as a result. From our project it is clear that lack of information is a clear barrier to determining the weed risk of some plant species, but as more information becomes available, assessments can be updated. The issues of spatial scale need to be considered when conducting WRM assessments, and with minimal effort, regional or local assessments can be performed to ascertain weed risk at those scales. To assist with regional priority setting and updating assessments as information becomes available, all completed and partially completed assessments from this project

and for many other weeds will be made available on a searchable online database that is under development (see Auld and Johnson 2014).

Weed Risk Management systems are frameworks for prioritising weeds for management and tools to aid in decision making. However, Panetta *et al.* (2001) suggest that decisions made using WRM assessments will only be successful when its tenets are accepted. Therefore, the WRM process and its outputs need to continue to be promoted, and if we are to be strategic, such processes need to be adopted with associated on-ground commitment.

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