

## 1. Introduction

*Tomorrow's weeds are already here.*

- Tim Low, Feral Future.<sup>1</sup>

These days you can't just go and bulldoze the bush. You can't tip nasty chemicals or garbage into creeks or natural areas. Killing native species mostly requires some sort of permit. But people are perfectly free to plant any one of thousands of invasive plant species that could degrade or destroy native bush and habitats for native species. Weed regulation lags far behind that of most other environmental threats.

Amongst the greatest leaps forward for the Australian environment (and agriculture) was the 1997 reform of quarantine to require risk assessment of new exotic species proposed for import into the country.<sup>2</sup> This has since prevented the importation of about 1500 potential new invaders.<sup>3</sup> But if a potentially invasive plant species is already in Australia, it is not subject to federal risk assessment, and unless it is banned by particular states it can be freely introduced into new areas. Due to lax laws, there are many thousands of invasive and potentially invasive plants that could cause damage over much larger areas than they currently do or become threats in the future.

The 2009 independent review of federal environment laws found that the movement of these species within Australia "is effectively unconstrained", that they "represent a vast reservoir of potential future problems", and that there has been "a substantial failure of State and Territory-based environmental regulation".<sup>4</sup>

With weeds already amongst the top threats to Australian biodiversity and costing at least \$4 billion a year in lost agricultural production and control costs, it should be a high priority to prevent the

release and spread of yet more weeds.

For the sake of both the environment and the economy, Australia needs to fully implement a prevention approach to weeds – to stop movement of potential invaders within Australia as well from overseas. Australia needs what is known as the 'permitted list' approach – requiring risk assessment of new plant species proposed for introduction – applied within the country as well as at the national borders.

## 2. What is a 'permitted list' approach to weeds?

*Prevention and early intervention are the most cost-effective techniques for managing weeds.*

- Natural Resource Management Ministerial Council, Australian Weeds Strategy.<sup>5</sup>

Weed prevention should be practiced both at the national border (pre-border) and internally (post-border) between states/territories, and also between regions. With quarantine regulations now restricting the import of new plant species to those assessed as low risk, the major weed risks arise from plant species that were imported into Australia prior to weed risk assessment, some of which have already naturalised (established in the wild outside their natural range). Risks can also arise from native plant species moved outside their natural range. Weed prevention requires that non-indigenous plants are not spread to new locations unless they are assessed as a low weed risk.

There are more than 26,000 exotic plant species in Australia, most in cultivation in gardens and paddocks (Table 1). More than 10% of these exotic species have already become established in the wild. Another 23% are weedy in other parts of the world, suggesting a potential

to become invasive in Australia.<sup>6</sup> There are also more than 11,000 native plant species in cultivation, some 5% of which have established in the wild outside their natural range.<sup>7</sup> About three-quarters of the exotic weedy species found in Australia started out as cultivated plants<sup>8</sup> (about 65% as garden/park plants and at least 8% as agricultural plants). Gardens comprise the major pool of future weeds. Many more new weeds are likely to come from this source than from accidental or illegal introductions.

Despite the large number of cultivated plants in Australia that are weeds or potential weeds, there are very few restrictions over their movement and sale. Assuming that species weedy in other countries are potentially invasive somewhere in Australia, there are about 9000 weeds or potential weeds in Australia,<sup>9</sup> but only a few hundred (about 460 taxa, including 40 genera) are subject to any form of legislative control in any one of Australia's states/territories, apart from Western Australia (Table 1). There are no restrictions on the sale or movement anywhere in Australia (apart from WA) of more than 90% of weeds or potential weeds and more than 80% of naturalised species. Many of the restricted plants are restricted only in some part of their potential range. A large number of invaders and potential invaders are available for trade in Australia – see Table 2. Of some 8700 garden species available through nursery catalogues and seed sellers in 2002, 12% were weeds somewhere in Australia.<sup>10</sup>

The unrestricted movement of thousands of weeds or potential weeds within most of Australia derives from the regulatory approach to non-native plants. In what is known as the 'prohibited list' or 'black list' approach, the sale and movement of all plant species are permitted except for those that are specifically banned by a state or territory.

# Stopping weed invasions: a 'white list' approach

**Table 1 Australian weed statistics**

<b>Exotic plant species in Australia (2007)</b>	26,242 (97% in cultivation) <sup>11</sup>
<b>Species introduced for ornamental purposes</b>	25,360 (94% of exotic introductions) <sup>12</sup>
<b>Species introduced for agricultural purposes</b>	>8200 (>31% of exotic introductions) <sup>13</sup>
<b>Naturalised exotic plant species in Australia</b>	2739 (>10% of exotic flora) <sup>14</sup>
<b>Rate of naturalisations of exotic species</b> (Note some figures are averages since colonisation, others are more recent rates)	Australia: average 12/year since European settlement, <sup>15</sup> 15-20/yr since 1980. <sup>16</sup> Qld: 12/yr, <sup>17</sup> Vic: 7.3/yr, <sup>18</sup> Tas: 6.4/yr, <sup>19</sup> NSW: 7.5/yr, <sup>20</sup> SA: 6/yr <sup>21</sup>
<b>Pathway of naturalised plant species</b>	65% as garden plants (for plants naturalising 1971-1995); <sup>22</sup> >8% as agricultural plants <sup>23</sup> (there are some overlaps)
<b>Exotic species not naturalised, but weedy outside Australia</b>	5907 <sup>24</sup> (23% of exotic flora)
<b>Weeds affecting the natural environment</b>	1765 (64% of naturalised species) <sup>25</sup>
<b>Weeds affecting agriculture</b>	~1290 (47% of naturalised species) <sup>26</sup>
<b>Exotic plant taxa restricted or prohibited in at least one state/territory within Australia</b>	~470 (this includes about 440 species, subspecies or hybrids and about 40 genera) <sup>27</sup> (<20% of naturalised species)
<b>Native plant species in cultivation (2007)</b>	11,119 <sup>28</sup>
<b>Invasive native plant species (2007)</b>	606 <sup>29</sup> (~ 5.5% of cultivated species)

**Table 2 Weeds listed in the Aussie Plant Finder**

<b>Invasive exotic plant species</b>	<b>Numbers listed as available in The Aussie plant finder (2002 or 2004)<sup>30</sup></b>
720 naturalised invasive and potentially invasive garden plants (in 2005) <sup>31</sup>	393 (54%) (in 2002)
178 invasive garden plants declared noxious by one or more States or Territories (in 2004) <sup>32</sup>	72 (40%) in one or more other states/territories (in 2002)
36 invasive plant species on the list of the World's 100 Worst Invasive Alien Species (in 2005) <sup>33</sup>	9 (25%) (in 2002)
127 weed species impacting threatened native species and ecological communities in NSW <sup>34</sup>	36 (28%) available in NSW in 2006, 56 (40%) in Australia
281 garden plants presenting a significant risk to Australian grazing industries <sup>35</sup>	69% available in 2004 (82% had no state/territory restrictions in 2006)

The implementation of a 'permitted list' or 'white list' approach would reverse this approach, banning the movement and sale of all species apart from those specifically permitted.<sup>36</sup>

The aim of a state/territory-based white-list approach would be to prevent the deliberate movement of:

- 1 Existing weeds into new regions where they are likely to invade.
- 2 Potential weeds into regions where they are likely to invade.<sup>37</sup>
- 3 Invasive or potentially invasive native plants outside their natural range.

A permitted-list approach involves developing a list of plant taxa<sup>38</sup> that can be legally sold and transported because they have passed a weed risk assessment and are deemed low risk. Taxa not on the list are automatically prohibited, unless they pass a risk assessment and are added to the list.

However, as applied to date, permitted lists generally also include taxa already traded in the jurisdiction, including those that are invasive or potentially invasive. Permitted lists have generally been used to draw 'a line in the sand' to prevent new potentially harmful introductions, but for maximum effectiveness they should also be used to reduce the number of existing permitted species to limit future naturalisations

Note: a listing in the The Aussie Plant Finder does not mean a particular species was sold or readily available.

and exacerbation of existing weed problems.

White-list restrictions would apply only to the sale or movement of plants, not their possession. Thus, landholders with non-permitted plants in their gardens or paddocks would not be breaking the law, except if the plants were on a prohibited list with conditions requiring landholders to remove those species or if they were breaching a duty of care.<sup>39</sup>

The permitted list approach is used in Australia at the national border, in Western Australia and in New Zealand. It is used in the Northern Territory for aquatic plants, and also by state and territory

**Table 3 The Australian Weeds Strategy (2006) – relevant principles, goals, actions**

<b>Principle 5</b>	Prevention and early intervention are the most cost-effective techniques for managing weeds.
<b>Goal 1</b>	Prevent new weed problems.
<b>Goal 1.3</b>	Reduce the spread of weeds to new areas within Australia.
<b>Action 1.3.2</b>	Develop and implement a national weed spread prevention plan that includes effective measures to prevent legal weed spread between jurisdictions.

governments for some categories of exotic animals.

Experience with these existing systems has shown that a permitted list approach is workable, effective and cost-effective, as discussed in the next section. It is consistent with the Australian Weeds Strategy, agreed to by federal and state/territory governments in 2006 (see Table 3). In fact, a permitted list approach is the only way to meet the prevention goals of the strategy.

### 3. Comparing the 'white list' and 'black list' approaches

*Currently, several thousand plant species persist as ornamentals or as naturalised populations in urban settings. They represent a vast reservoir of potential future problems. Movement of these species within Australia is effectively unconstrained ...*

*[This] represents a substantial failure of State and Territory-based environmental regulation*

- Allen Hawke, Independent Review of the Environment Protection & Biodiversity Conservation Act 1999.<sup>40</sup>

The black-list-only approach allows the sale and

**Table 4 Weeds prohibited and permitted under different approaches**

Jurisdiction	Regulatory approach	# taxa prohibited/controlled	# species permitted
States & Territories (not WA)	Prohibited/ restricted list only <sup>43</sup>	~425 species, subspecies, hybrids, aggregates & ~40 genera (in at least one state/territory) <sup>44</sup> Vic: 135, NSW: 223, SA: 146, Tas: 145, Qld 131, NT: 148, ACT 87.	~26,000 (of the exotic species in Australia, plus any smuggled from overseas)
Western Australia	Permitted list	1369 on the quarantine prohibited list ~11,600 exotic species in Australia requiring risk assessment if proposed for import ~400,000 <sup>45</sup> species globally requiring risk assessment if proposed for import to WA.	13,202 <sup>46</sup>
Federal	Permitted list <sup>47</sup>	~360,000 (total number of global species requiring risk assessment if proposed for import to Australia) <sup>48</sup>	~36,000 <sup>49</sup>

**Table 5 Outcomes of permitted list systems**

Jurisdiction	Number species assessed	Number permitted	Number rejected	Number requiring further evaluation <sup>50</sup>
WA (1998-2004) <sup>51</sup>	5869	5459 (93%)	410 (7%)	–
Federal (1997-2007) <sup>52</sup>	3300	1815 (55%)	792 (24%)	693 (21%)

movement of all introduced plant species apart from those on a prohibited (or noxious weeds) list.<sup>41</sup> The white list system takes the opposite approach of banning all species unless they are on a permitted list.<sup>42</sup> The latter results in a much larger number of weeds being prevented entry, as Tables 4 and 5 show. The difference between the approaches is often summed up as treating species as harmless unless proven otherwise (black list) versus treating species as harmful unless proven otherwise (white list).

#### 3.1 Preventative and systematic versus reactive and ad hoc

*The development of a list of permitted, non-invasive taxa, applied in a consistent manner across all States and Territories, could represent the most effective and timely response to the immediate threat posed by thousands of potentially invasive and unrestricted plant species.*

- Steve Csurhes, Rod Randall, Christian Goninon, Alice Beilby, Stephen Johnson and John Weiss, Turn the tap off before you mop up the spill.<sup>53</sup>

White list systems can comprehensively prevent the

introduction of new weeds, depending upon how effective and precautionary the weed risk assessment is.<sup>54</sup> In a decade of operation, the federal system prevented the entry of about 1500 exotic species (see Table 5), consisting of about 800 rejected as a weed risk and another 700 requiring further evaluation (which has not proceeded).<sup>55</sup> In the first six years of operation Western Australia prevented the entry of 410 plants assessed as a weed risk (see Table 5).

Tests of the federal weed risk assessment protocol on known weeds found that it correctly predicted 90% of weeds and 70% of non-weeds, so some weeds are still likely to gain entry and some non-weeds are likely to be rejected.<sup>56</sup> The system is precautionary in rejecting plant imports that are likely to become weeds with no certainty that they would.<sup>57</sup> It is systematic in requiring a risk assessment for all new species proposed for import.

Black list systems mostly result in bans on species that have already established, and often long after it is too late to eradicate them. Most declaration processes are slow and onerous. They can be preventative by banning species before they are introduced, but this is done on an ad hoc, occasional basis rather than systematically.<sup>58</sup> It is not realistic to assess the many thousands of potential weeds that could be introduced to determine which should be prohibited.<sup>59</sup> The system is generally non-precautionary in allowing the entry of plant species likely to be weedy with no assessment of risk.

## 3.2 Effective versus ineffective against illegal introductions

*By preventing the sale of all non-assessed plant species, a permitted-list ... could also remove the commercial incentive to smuggle plant species into Australia.*

- Steve Csurhes, Rod Randall, Christian Goninon, Alice Beilby, Stephen Johnson and John Weiss, Turn the tap off before you mop up the spill.<sup>60</sup>

Because black list systems permit the sale and movement of any plant species except the 100-200 typically banned in any state or territory, any illegally imported species can be sold once they have crossed the national quarantine barrier.<sup>61</sup> Seeds sourced via the internet and from international mail-order seed companies are likely to be a growing source of potential new weeds.<sup>62</sup> This is difficult to prevent. Black list approaches can provide a "second line of defence" to national quarantine by making it illegal to sell any species except those on a permitted list.<sup>63</sup> Prospective commercial smugglers are less likely to smuggle seeds into Australia if they are unable to legally sell them.

## 3.3 Cost-effective with priority accorded to the public interest versus costly with priority accorded to private interests

*The problem that seems inadequately treated currently is that a substantial benefit to a few has more political weight than a substantial cost that might be borne forever by all.*

- Daniel Simberloff, The politics of assessing risk for biological invasions.<sup>64</sup>

*Weed declarations have probably been influenced more by politics, institutional arrangements and community attitudes to weeds than scientific considerations ... compounded by ... the political nature of the process and competing interests for 'new' and 'better' plants adding to the number of weeds establishing and spreading.*

- Australian Weeds Committee, Principles of Weeds Legislation Discussion Paper.<sup>65</sup>

Allowing unrestricted entry to weeds and potential weeds can be very costly – to the public (who pay for weed control on public lands), to particular industry sectors or land managers (who suffer production losses and pay for control on private lands) and to the environment. Conversely, the economic benefits of preventing further weed introductions are very high. Weeds already cause at least an annual \$4 billion cost to agriculture,<sup>66</sup> which averages out at more than \$3 million/agricultural weed/year (see Table 1) and represents a loss of \$1 in every \$7 of agricultural income. A Queensland modeling assessment found that preventing the spread of new invasive species can generate a mean benefit-cost ratio of \$32.67. An assessment of Australia's permitted list system found it could provide a net economic benefit of \$40 billion (net present value) over the next century by preventing the import of invasive garden plants (assuming a 10% rate of invasion).<sup>68</sup>

While white list systems can result in rejection of some species that would not become weedy and therefore deprive some people of benefits they might derive from those species, the overall high benefit-cost ratio justifies some potential losses. This is especially so for garden plants, whose benefits are primarily aesthetic and for which there are safer alternatives.

The costs of particular weeds can be enormous (see Table 6), which means the "grief brought by one rogue species often exceeds the benefit bestowed by many harmless species."<sup>69</sup> For example, Lippia (*Phyla canescens*) is estimated to cost the grazing industry \$38 million a year (and has an estimated environmental cost of \$1.8 billion a year).<sup>70</sup> It has been sold as a low-maintenance lawn cover and garden ornamental in most states, and is restricted only in some parts of NSW.<sup>71</sup> The environmental costs of weeds are difficult to document

**Table 6 Examples of estimated weed costs to the economy**

<b>Total agricultural losses &amp; costs of control (a conservative mean estimate)</b>	\$3927 million/yr <sup>72</sup>
<b>Lippia (<i>Phyla candescens</i>)</b>	Grazing industry: \$38 million/yr <sup>73</sup>
<b>Serrated tussock (<i>Nassella trichotoma</i>)<sup>74</sup></b>	Grazing impacts: \$45 million/yr <sup>75</sup>
<b>Patterson's curse (<i>Echium plantagineum</i>)</b>	Grazing impacts: \$30 million/yr <sup>76</sup>
<b>Parthenium (<i>Parthenium hysterophorus</i>)</b>	Grazing and crop impacts: \$22 million/yr <sup>77</sup>
<b>Prickly acacia (<i>Acacia nilotica ssp indica</i>)</b>	Grazing impacts: \$4-9 million/yr <sup>78</sup>

as they are in terms of threatened species, degraded ecological communities and loss of ecosystem functions, and there is limited information about their impacts (see table 7).

A black list approach gives priority to short-term private benefits gained from the sale and use of potentially weedy species over long-term public interests in limiting weed impacts on the environment and the economy. It is often politically difficult to ban a plant after it has already been introduced when it is valued by some sector of the community. This is the case even for the most serious weeds (eg. gamba grass, hymenachne and willows). There is much less political conflict associated with banning plants before they are introduced because there are no existing benefits to compromise.

**Table 7 Examples of weed costs to the environment**

<b>NSW threatened plant species (569 species in 2006)</b>	Weeds threaten 279 species (49%) <sup>79</sup>
<b>NSW threatened animal species (271 species in 2006)</b>	Weeds threaten 62 species (23%) <sup>80</sup>
<b>NSW threatened ecological communities (72 communities in 2006)</b>	Weeds threaten 64 communities (89%) <sup>81</sup>
<b>Federally threatened ecological communities (47 in Feb, 2010)</b>	Weeds threaten 39 communities (83%) <sup>82</sup>
<b>Federally threatened species (in 2006)</b>	Weeds threaten 291 species <sup>83</sup>
<b>Federally threatened species (in 2006)</b>	Weeds threaten 291 species <sup>83</sup>
<b>Landscape degradation</b>	>20 million ha of natural areas and grazing lands degraded by 6 of Australia's worst weeds <sup>84</sup> Blackberry: 8 million ha Prickly acacia: 6.6 million ha Lantana: 4 million ha
<b>Impacts of lantana (<i>Lantana camara</i>)</b>	Threatens 83 plant species, 2 animal species, and 15 ecological communities listed as threatened in NSW <sup>85</sup>
<b>Impacts of bitou bush (<i>Chrysanthemoides monilifera ssp. rotundata</i>)</b>	Threatens 158 native plant species <sup>86</sup>
<b>Control costs in conservation areas (2001-02)</b>	\$19.6 million <sup>87</sup>

## The permitted list approach of WA

Based on a fact sheet by the Weeds CRC (2005)<sup>88</sup>

Western Australia adopted a permitted list system in 1997. To develop an initial list, the WA government contacted 1000 importers who had imported plant materials in the previous five years to ask for stock lists, and 120 responded. In three months, two staff compiled a preliminary permitted list of more than 7000 species.

In the first six years of operation, about 6000 species were assessed, 93% of which were added to the permitted list. (There are currently 13,000 non-native plant species on WA's permitted list.) The risk assessments were mostly completed within 24 hours (because most were common in horticulture and their potential impacts known) by one staff member.

There were apparently no complaints in Western Australia about the permitted list system over its first six years of operation – just some complaints about specific assessments, which is to be expected.

Compliance is focused mostly on large wholesalers in eastern states. According to the CRC, "these importers accept it as just another bureaucratic requirement, and any problems are generally due to failures in other aspects of quarantine compliance". Furthermore, "most importers, once they understand how the permitted list operates, are happy to meet the requirements."

## 4. Implementing a permitted list approach – logistics, issues and costs

### 4.1 Achieving consistency between states and territories, and with the federal system

To achieve maximum effectiveness, a consistent permitted list system should be implemented by all states and territories.<sup>89</sup> This would assist industry by eliminating the current ad hoc differences between jurisdictions, reducing confusion and providing a more "level playing field" across the nation.<sup>90</sup> State and territory governments could achieve efficiencies by sharing information and resources to conduct risk assessments and construct permitted lists.<sup>91</sup>

This approach could be complemented by using federal environment laws (the Environment Protection and Biodiversity Conservation Act 1999, EPBC Act) to adopt national lists of different categories of invasive species and to prohibit the sale and movement of invasive and potentially invasive plant species threatening to biodiversity. The 2009 independent review of the EPBC Act has recommended that:

*the Council of Australian Governments (COAG) develop criteria and management protocols for the movement of potentially damaging exotic species between States and Territories, working towards a list of 'controlled' species for which cost-effective risk-mitigation measures may be implemented.*<sup>92</sup>

This recommended COAG process could be used to negotiate an agreement to implement consistent white-list approaches Australia-wide.

We also recommend the development of national lists of different weed categories under the EPBC Act – eg. a

national control list and a national alert list – that restrict the sale and movement of invasive or potentially invasive plant species threatening to biodiversity.<sup>93</sup>

### 4.2 Applying a white list comprehensively – existing invaders, native species, genetic variants

A permitted list approach – allowing only taxa assessed as low risk – tends to be used to draw a line in the sand against introductions of new potentially invasive species rather than be applied to all species being moved into a state, territory or country. In the case of the federal system, international trade laws forbade the government to ban a species already in the country unless it was under 'official control' (by the state or territory governments). This means that the federal permitted list contains a large number of invasive and potentially invasive species.

Prevention of weed spread requires that existing species also be assessed for weed risk and prohibited where they could result in new invasions or exacerbate existing invasions. A comprehensive permitted list approach could be implemented in stages:

**Stage 1:** A 'line in the sand' stage focused on preventing new potentially invasive species. The permitted list would consist of both low-risk species and species traded within the previous 2-3 years (and not already prohibited).

**Stage 2:** A 'rationalisation' stage of assessing permitted species to determine which of the species previously accepted as part of the status quo should be prohibited on the basis of weed risk. There are likely to be different criteria applied in this

assessment to include consideration of whether prohibition would achieve prevention goals. Some cost-benefit analysis may be applied in a small subset of cases involving highly valued species.<sup>94</sup>

A permitted list approach should include not only species exotic to Australia, but native species proposed for introduction outside their range. About 5% of native species grown outside their natural range have already naturalised (see Table 1), and their impacts can be just as severe as those of exotic species.

A permitted list approach should also be applied to new taxa (subspecies, cultivars) of existing non-native plant species if their introduction could result in a new weed problem or exacerbate an existing problem. Some new varieties of existing weeds may be more invasive – if they have been bred to be drought-hardy, for example – or they may hybridise with existing varieties and increase invasiveness.<sup>95</sup> Risk assessment is typically applied to species, and distinguishing the impacts of lower-level taxa (subspecies, varieties and forms) could be difficult in some cases. It would require identifying the taxa already in cultivation or naturalised so as to identify novel taxa proposed for introduction. Initially, risk assessment could be applied to certain categories of taxa, eg. those with particular characteristics achieved by breeding that are likely to increase invasiveness and those related to high-impact weeds.

### 4.3 Considering economically valuable species

*It seems remarkable that I can be fined several hundred dollars for littering, an act of environmental vandalism that can be fixed in ten seconds and generally causes no lasting damage, but those responsible for introducing plants and animals that pollute the nation forever and*

cost the Australian economy millions get off 'scott free'.  
– Hugh Possingham, Ecology Centre, University of Queensland.

No matter whether a prohibited-list or permitted-list system is used, decisions about economically valuable (or otherwise highly valued) invasive species are likely to be contentious. Unsurprisingly, there is often strong resistance to banning these plants by those who benefit from them. However, in contrast to the environmental impacts of weeds, which are centuries or millennia-long and essentially unpredictable, the majority of economic benefits from weedy species tend to be short-term and replaceable to at least some extent by other species, either low-risk exotic or indigenous species.<sup>96</sup> This is particularly the case with garden plants, for which there are thousands of safe alternatives.

We do not recommend the alternative approach of cost-benefit analysis for introductions of new species, for:

*...weed costs are impossible to predict or calculate in advance. And when environmental harm is involved there is no acceptable way of measuring it. After a plant becomes a weed it is likely to remain in the landscape forever, and any cost-benefit analysis conducted today may lack meaning in a thousand years time. The economic approach can also lead to unfair outcomes because the benefits and costs of a plant usually flow to different sectors, and there is no accepted way to make those who benefit from a plant pay those who bear the costs.*<sup>97</sup>

However, some form of cost-benefit analysis may be used to inform decisions about some commercially valuable species if they are already present within a state/territory (proposed stage 2 process). This is preferable to the weed risks of these species being ignored. Currently, under

black list systems such species are not typically even considered for prohibition. These cases should represent a small proportion of species, but may involve some of the most invasive species. Given the high, long-term costs of invasions, cost-benefit analysis should find that there is greater economic benefit in preventing the further spread of most weed species than in growing them for profit. Assessments should also consider that in many cases there are alternatives to invasive plants for gardeners (eg. as documented in 'Grow me instead' publications) and graziers. Some reduction in exotic choices will not stop gardeners to buying plants from nurseries.

## 4.4 Logistics and resources

Experience with white list approaches has shown that they need not be very costly to implement. Based on Western Australia's experience (see Box 1), a permitted list could be compiled in one to two years.<sup>98</sup> A small staff (consisting of just one employee in Western Australia) could develop and maintain the list. The cost depends on the nature of the risk assessment and how long it takes – typically just one day per assessment in Western Australia.<sup>99</sup> Great efficiencies could be attained if states and territories adopted the same weed risk assessment processes and cooperated in the development of permitted lists, or if some assessments were done nationally. However, compliance costs would probably increase as there would need to be more monitoring of points of sale.

## 5. Conclusion

*New garden plants should be treated less like exciting new products to brighten our lives and more like wild organisms harbouring the drive to escape.*

– Tim Low, Feral Future

Sooner or later, Australia's states and territories are likely to introduce a permitted list approach to non-native plants. It is the only practicable way to prevent new weeds, and has been shown to be effective and workable. It would save money and biodiversity if such a system was comprehensively introduced sooner rather than later. Introducing a permitted-list system now rather than a decade later could mean hundreds of fewer weed infestations. It is time to adopt a realistic approach to non-native species – to treat them as potential threats to the environment and agriculture unless assessed otherwise.

## 6. Recommendations

- All Australian states and territories adopt a consistent permitted-list approach to the sale and introduction of non-native plant species.
- In stage 1, maintain the status quo for existing traded species and require risk assessments of all new taxa proposed for introduction into a state or territory.
- In stage 2, rationalise the permitted list by assessing all species not assessed in stage 1 to determine which should be prohibited.
- Apply risk assessment to native species moved outside their natural range and lower-level taxa (cultivars, subspecies).
- Develop national lists of different weed categories under federal environment law – eg. a national control list and a national alert list – and apply prohibitions on the sale and movement of invasive or potentially invasive plant species threatening to biodiversity.

## Endnotes

- 1 Low (1999).
- 2 From July 1998, under the Quarantine Proclamation 1998, all plant species were prohibited from entering Australia until they were formally assessed and/or appeared on the Permitted Seeds List.
- 3 Riddle et al. (2008). This includes species rejected and species requiring further evaluation. With no protocol for further evaluation, this amounts to at least a temporary refusal.
- 4 Hawke (2009).
- 5 NRMCC (2006).
- 6 Panetta et al. (2001): Weediness in one part of the world is highly predictive for weediness elsewhere.
- 7 There is a total of 36,630 separate species in cultivation in Australia (Randall 2007).
- 8 Groves et al. (2003); Cook and Dias (2006).
- 9 Other species may turn out to be weeds as well, particularly those that do not have a history of introduction elsewhere that might have revealed a tendency for invasion. In addition, changing conditions in future (eg. climate change or disturbance or introduction to a new habitat) may facilitate other species to become invasive. Most have not been here for very long in ecological terms. Many foreign plants in cultivation are thought to be 'sleepers', which means they may become weedy in future (Groves 1999).
- 10 Groves et al. (2005).
- 11 Randall (2007).
- 12 Groves et al. (2005).
- 13 Cook and Dias (2006). Some species were introduced at different times for both agricultural and ornamental purposes. The 8200 species are a minimum estimate because they represent only those brought in under the Commonwealth Plant Introduction scheme over about 80 years, just one of the agricultural plant introduction schemes operating during the 20th century in Australia. The number of introductions for agricultural purposes have been underestimated in most publications.
- 14 Randall (2007).
- 15 This is the average since colonisation: 2739 over 220 years. Groves (1997) estimated an average naturalisation rate of 10/year. He found the rate had increased in more recent years.
- 16 Groves (1997); Martin (2003).
- 17 Batianoff and Butler (2004).
- 18 Commissioner for Environmental Sustainability (2008), citing Weiss (2007).
- 19 Rozefelds et al. (1999) – this was the estimated rate from 1970-1995.
- 20 This is the average rate since colonisation (1165 in total). The rate has increased in recent times with the discovery of dozens more naturalised species in recent years. Also see Groves (2002).
- 21 Weed Management Society of South Australia Inc. (nd)
- 22 Groves (1997).
- 23 Cook and Dias (2006).
- 24 Randall (2007).
- 25 Groves et al. (2005). DAFF (2007) says 68% of naturalised plant species affect natural ecosystems. Groves et al. (2003) found that 798 species (about 30% of naturalised species) were considered a major problem and 1388 species (about 50%) a minor problem to managers of natural ecosystems.
- 26 DAFF (2007).
- 27 Australian Weeds Committee (2010)..
- 28 Randall (2007).
- 29 Randall (2007).
- 30 Hibbert (2002). The Aussie Plant Finder lists about 30,000 species and cultivars said to be available through nurseries and seed sellers. However, some of its listings were out-of-date and a listing does not mean a particular species was being sold. Therefore, the numbers should be taken as indicative only in the absence of better information. On the other hand, the Finder does not include garden species available from many points of sale in Australia, including nurseries, and private and internet sales.
- 31 Groves et al. (2005).
- 32 Groves et al. (2005).
- 33 Groves et al. (2005).
- 34 Coutts-Smith and Downey (2006).
- 35 Barker et al. (2006). They are the species identified as representing "the greatest potential threat to the grazing industries of Australia." They are weeds outside Australia and they had been available through Australian nurseries or Australian seed suppliers during the previous 20 years.
- 36 A white list is complemented by a black list that contains those species already banned, those that do not pass a weed risk assessment and those species which should be controlled by landholders or for which there are restrictions in certain areas.
- 37 They may be non-invasive in their current distribution because the climate or habitat is unsuitable, or they are 'sleepers' and will become invasive in future.
- 38 Different subspecies and cultivars can differ greatly in their invasive potential, so risk assessment should apply to taxonomic levels lower than species in some cases.
- 39 Csurhes et al. (2006) note this limits capacity to address the risks associated with private plant collectors.
- 40 Hawke (2009).
- 41 There are a number of different terms used in states/territories for those plant taxa on a black list: "noxious weeds", "declared weeds", "declared plants", "pest plants" or "proclaimed plants" (Australian Weeds Committee 2002).
- 42 They also have a black list, which includes those species already assessed as too risky or previously banned.
- 43 Except for the Northern Territory, which has a permitted list for aquatic plants.
- 44 Australian Weeds Committee (2010). Some are restricted only in one or more local government areas or regions.
- 45 The iPlant database says there are 422,000 known species of plants globally (iPlants nd), and Australia has close to 18,000 native vascular plant species (Orchard 1999).
- 46 WA Department of Agriculture and Food (2007).
- 47 AQIS (nd): "Species not listed on the 'Permitted Seeds List' and ICON are prohibited entry and may only be imported under an Import Permit and will require an assessment to determine their weed and quarantine risk."
- 48 iPlants (nd).
- 49 Australian Government (2009).
- 50 There is no process as yet for further evaluation, so this designation in effect means prohibition (for now).
- 51 McFadyen (2005).
- 52 Riddle et al. (2008).
- 53 Csurhes et al. (2006) are all State and Territory government weed scientists/officers. Their paper specifies that it was written to stimulate discussion and does not represent government policy.
- 54 The extent of precaution applied depends on the level of certainty associated with particular assessments (Low 2005). Many assessments are not precautionary because the certainty is high that a species will become weedy when introduced – eg. if it is a weed elsewhere and the climate is suitable. There is much greater uncertainty if a species is not known to be a weed elsewhere, and has no weedy relatives.
- 55 There is as yet no federal protocol for assessing those plant taxa deemed as requiring further evaluation, so this outcome acts as a prohibition for now.
- 56 Gordon et al. (2008). This study assessed the accuracy across different countries in which it had been tested.



57 Low (2005).

58 While it would be possible to ban the majority of potential weeds under a prohibited list approach, in reality this would not occur because it would mean conducting a risk assessment of the many thousands of plant species that could be introduced. It would be a huge waste of resources.

59 Csurhes et al. (2006): "To deliver comparable savings, a prohibited list approach would need to involve risk assessment of a much larger pool of species, possibly the entire world plant flora if one accepts that any plant species can be smuggled into Australia."

60 Csurhes et al. (2006).

61 Csurhes et al. (2006).

62 There is no information about the extent of seed smuggling. It is likely to be substantial. An estimated 5-10% of ornamental fish (~300,000-600,000 fish per year) imported into Australia are smuggled, according to the Pet Industry Joint Advisory Council (McNee 2002, citing AQIS 1999).

63 Csurhes et al. (2006).

64 Simberloff (2005).

65 Australian Weeds Committee (2002).

66 Sinden et al. (2004). The figure is conservative because of the limited data available to use for the economic assessment.

67 AEC Group (2006).

68 Keller et al. (2007). They used very conservative assumptions, including that each of the plant species prohibited import would cost the industry \$410,000, without factoring in that consumers would compensate for this loss by buying non-invasive species. The \$40 billion estimate assumed a 10% base rate of invasion, 90% accuracy of weed risk assessment, and used a hyperbolic discount rate. They found that weed risk assessment accuracies as low as 69% may represent rational policy, depending upon the discount rate used.

69 Low (2005).

70 Julien et al. (2004).

71 The NSW Farmers Association (2004) said this about the continued sale of lippia in NSW: "The fact that Lippia is marketed and sold as a low maintenance, "no mow" turf hinders any attempt to control Lippia

72 Sinden et al. (2004).

73 Julien et al. (2004).

74 While it was introduced accidentally, serrated tussock was also grown as an ornamental (Groves et al. 2005, citing Randall pers. comm.).

75 Jones and Vere (1998).

76 Industries Assistance Commission (1985).

77 Agriculture & Resource Management Council of Australia & New Zealand et al. (2000).

78 Spies and March (2005).

79 Coutts-Smith and Downey (2006).

80 Coutts-Smith and Downey (2006).

81 Coutts-Smith and Downey (2006).

82 Noted in the listing or conservation advice issued by the federal Threatened Species Advisory Committee (and in one case in an external source when no advice was available). See <http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl>. Accessed 7 February 2010.

83 Coutts-Smith and Downey (2006), citing Downey (unpublished).

84 Martin (2003).

85 NSW Scientific Committee (2006).

86 NSW DEC (2006)

87 Sinden et al. (2004). This estimate included state and federal government costs in national parks and funding from the Natural Heritage Trust.

88 McFadyen (2005).

89 Glanznig (2005); Csurhes et al. (2006).

90 Csurhes et al. (2006). A joint or consistent approach would avoid issues with national competition policy or mutual recognition laws.

91 Csurhes et al. (2006); Glanznig (in press 2010).

92 Hawke (2009).

93 This can be done under existing provisions of the EPBC Act (s301A), which have not yet been enacted.

94 It is difficult to do cost-benefit analysis due to data limitations. It should only apply to a few high-value species. In most cases the costs of weeds outweigh benefits because control costs are ongoing while benefits are often only short-term or can be obtained by using non-weedy species.

95 See Booth (2009) and references therein.

96 Panetta et al. (2001). An analysis of agricultural introductions to New Zealand found that most introductions contributed little to the economy and that 'important species' (those that covered more than 1% of cultivated area) had effective life spans of only about 10 years (Ibid., citing Halloy 1999).

97 Low (2005).

98 McFadyen (2005); Csurhes et al. (2006).

99 Of costs for the federal system of weed risk assessment, Keller et

al. (2007) say they "estimated the total required full-time staff at four, based on an average [risk assessment] taking 2 days to complete, and some extra duties. Assuming average pay scales and overhead, we have estimated the annual cost of administering [risk assessment] to be \$300,000."

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Acknowledgements: Thank you for funding support from the Norman Wettenhall Foundation. Thank you to reviewers.