

## Assessing new Weeds of National Significance candidates

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**Summary** Sixteen weeds were nominated as new Weeds of National Significance (WoNS) candidates. The nominations were assessed against a number of criteria covering technical and policy considerations. The technical assessment was carried out using the revised WoNS prioritisation methodology. As part of the technical assessment a combination of risk models were tested in consultation with a range of experts in weed risk assessment. The different models showed consistent results in identifying the top ranking weeds and low ranking weeds, regardless of the scoring model used. The combination of using the revised WoNS prioritisation methodology, consultation with the jurisdictions, and policy considerations, formed a comprehensive and transparent assessment process. The process resulted in the selection of 12 new WoNS to be added to Australia's 'worst weed' list.

**Keywords** Assessment, methodology, Weeds of National Significance.

### INTRODUCTION

Weeds of National Significance (WoNS) are established weeds that have major adverse effects on Australia's primary production industries, the environment and social amenity. A nationally coordinated, strategic management approach is applied to WoNS across Australia's states and territories. The main aim of this approach is to develop and implement best practice management in order to reduce impact of WoNS and limit further spread.

In 2009 the Bureau of Rural Sciences (now the Australian Bureau of Agricultural and Resource Economics and Sciences, ABARES), was commissioned by the Australian Weeds Committee (AWC) to develop a revised WoNS prioritisation methodology, herein referred to as the 'revised methodology' (Lizzio *et al.* 2010), based on the original WoNS assessment process (Thorpe and Lynch 2000). The purpose of the WoNS prioritisation methodology is to rank weeds which could be considered WoNS because of their potential adverse impacts on agricultural and forestry industries and the environment.

The revised methodology was endorsed by the AWC for use in assessing new WoNS candidates. In 2010 the AWC, in consultation with all government

jurisdictions and weed experts, selected 16 weeds for possible addition to the list of WoNS.

The new WoNS candidates were ranked against their capacity to invade, spread, and cause an impact (social, environmental and economic), and the feasibility of their control. This paper summarises the process undertaken and results from assessing the candidate weeds against the revised methodology.

### ASSESSMENT PROCESS

The revised methodology is based on four major criteria that make a weed nationally significant (invasiveness, impact, potential for spread and socio-economic and environmental values) (Lizzio *et al.* 2010). For each of the four criteria a range of questions were designed to assess and rank weeds. State and territory governments provided ABARES with information and distribution data for each of the 16 weeds nominated as potential new WoNS to address the questions under the four criteria in the revised methodology.

ABARES validated the information and data and entered them into a 'prioritisation template'. The weed distribution data was supplied by the jurisdictions in a multitude of different, non-compatible spatial formats and projections and this data was converted by ABARES into a suitable format for analysis. The candidate WoNS were ranked according to their total score arising from the template. The initial rankings based on unweighted criteria are below (Table 1).

The technical assessments by ABARES were peer reviewed at a workshop attended by experts in weed risk assessment with a broad knowledge of the weeds nominated as potential new WoNS. The aim of the workshop was to:

- (1) address data gaps for particular nominated weeds/criteria, so that all weeds have a score for each question;
- (2) raise and address any inconsistencies in how weeds were scored for particular questions; and
- (3) examine the relative influence of different questions and criteria on the rankings of the weeds.

A range of concerns on definition, interpretation and intention of questions under the four criteria and developed alternative approaches to address these concerns were identified in the workshop. For example, question

**Table 1.** Initial rankings of candidate WoNS based on unweighted criteria.

Weeds	Common Name	Ranking
<i>Anredera cordifolia</i>	Madeira vine	1
<i>Jatropha gossypifolia</i>	Bellyache bush	2
<i>Andropogon gayanus</i>	Gamba grass	3
<i>Euphorbia paralias</i>	Sea spurge	4
<i>Cytisus scoparius</i>	Scotch broom	5
<i>Sagittaria platyphylla</i>	Arrowhead	6
<i>Senecio madagascariensis</i>	Fireweed	7
<i>Asparagus</i> spp.	Asparagus weeds	=8
<i>Sporobolus pyramidalis</i>	Giant rat's tail grass	=8
<i>Opuntia</i> spp	Opuntoid cacti	10
<i>Eichhornia crassipes</i>	Water hyacinth	11
<i>Macfadyena unguis-cati</i>	Cat's claw creeper	12
<i>Genista monspessulana</i>	Montpellier broom	13
<i>Lycium ferocissimum</i>	Boxthorn	14
<i>Cylindropuntia rosea</i>	Hudson pear	15
<i>Solanum elaeagnifolium</i>	Silver leaf nightshade	16

A6 assessed the 'long-distance dispersal' potential of weeds and averaged the three scores for wind, water and flying birds/wild terrestrial vertebrates (Mewett *et al.* 2011). It was concluded that averaging out the three scores prevented differentiation between the dispersal routes that the question intended to achieve. As a result it was agreed to add up the scores for the three dispersal categories instead of averaging the scores.

Overall, alternative approaches were developed for questions A5 (reproductive method), A6 (long-distance dispersal), A8 (routine weed control), D1–D3 (environmental impacts), D6 (economic impact) and section C (current and potential distribution data). The jurisdictions subsequently provided ABARES with additional data to include in the alternative assessment approaches.

ABARES tested three risk models (using the parameters of invasiveness, impacts, spread, and socio-economic and environmental values) which were proposed to the AWC for consideration.

- 1)  $(\text{Invasiveness} + \text{Spread}) \times (\text{Impacts} + \text{Value})$
  - 2)  $\text{Invasiveness} + \text{Spread} + \text{Impacts} + \text{Value}$
  - 3)  $\text{Invasiveness} \times \text{Spread} \times \text{Impacts} \times \text{Value}$
- Equal weighting was applied to each of the four criteria.

**Model 1: (Invasiveness + Spread) × (Impacts + Value)** Applying risk model 1 revealed that both 'raw' and 'equal weighted' resulted in similar rankings

of the candidate weeds (Table 2). The two exceptions are silver leaf nightshade (*S. elaeagnifolium*) changing from a rank of 9 to a rank of 12; and boxthorn (*L. ferocissimum*) changing from a rank of 13 to a rank of 10. 'Raw' meant that only the model scoring formula has been applied; and 'equal weighted' means that each criterion's scores were rationalised to be of equal weighting (in this case a score out of 10) before the model scoring formula was applied.

In regard to weightings, it was suggested at the workshop that once the different scoring scenarios as outlined above had been completed, that ABARES would repeat the analysis but rationalise each section's scores to be of equal weighting; for example, make each of sections A, B, C, and D a score out of 10. The results of this analysis are also presented in Table 2.

**Table 2.** Scoring result for model 1 based on the 'raw' and 'equal weighted' scores.

Common Name	Scores		Rank	
	Raw	Equal weighted	Raw	Equal weighted
Gamba grass	319.7	180.7	1	1
Water hyacinth	296.7	173.5	2	2
Madeira vine	277.0	156.4	3	3
Arrowhead	266.5	142.7	4	4
Montpellier broom	201.4	122.6	6	5
Bellyache bush	208.8	121.4	5	6
Scotch broom	200.2	105.2	7	7
Cat's claw creeper	173.4	102.2	8	8
Opuntoid cacti	163.2	97.7	10	9
Boxthorn	142.6	87.3	13	10
Asparagus weeds	155.0	84.6	11	11
Silver leaf nightshade	165.0	83.3	9	12
Fireweed	154.8	82.8	12	13
Sea Spurge	125.0	69.9	14	14
Giant rat's tail grass	117.3	62.8	15	15
Hudson pear	108.2	62.4	16	16

**Model 2: Invasiveness + Spread + Impacts + Value** When risk model 2 was applied only minor differences between 'raw' and 'equal weighed' were observed (Table 3). The exceptions are silver leaf nightshade (*S. elaeagnifolium*) changing from a rank of 9 to a rank of 13; Opuntoid cacti (*Opuntia* spp.) changing from a rank of 11 to a rank of 9; and boxthorn (*L. ferocissimum*) changing from a rank of 13 to a rank of 10.

**Table 3.** Scoring results for model 2 based on both ‘raw’ and ‘equal weighted’ scores.

Common Name	Scores		Rank	
	Raw	Equal weighted	Raw	Raw
Gamba grass	36.0	27.2	1	1
Water hyacinth	34.8	26.5	2	2
Madeira vine	33.4	25.0	3	3
Arrowhead	32.7	23.9	4	4
Montpellier broom	28.4	22.2	7	5
Bellyache bush	29.0	22.1	5	6
Scotch broom	28.7	21.1	6	7
Cat's claw creeper	26.4	20.2	8	8
Opuntoid cacti	25.7	19.8	11	9
Boxthorn	24.0	18.7	13	10
Fireweed	25.7	18.5	10	11
Asparagus weeds	25.3	18.4	12	12
Silver leaf nightshade	26.0	18.4	9	13
Sea spurge	23.3	17.1	14	14
Giant rat's tail grass	22.4	16.2	15	15
Hudson pear	21.0	15.9	16	16

**Model 3: Invasiveness × Spread × Impacts × Value**  
Application of model 3 resulted in no difference in the final ranking between ‘raw’ or ‘equal weighted’ (Table 4).

**Table 4.** Scoring results for model 3 based on both ‘raw’ and ‘equal weighted’ scores.

Common Name	Scores		Rank	
	Raw	Equal weighted	Raw	Equal weighted
Gamba grass	4599.8	1996.5	1	1
Water hyacinth	4113.0	1785.2	2	2
Madeira vine	3288.3	1427.2	3	3
Arrowhead	2775.3	1204.6	4	4
Montpellier broom	2068.8	897.9	5	5
Bellyache bush	2029.8	881.0	6	6
Scotch broom	1356.0	588.5	7	7
Cat's claw creeper	1244.8	540.3	8	8
Opuntoid cacti	1075.9	467.0	9	9
Boxthorn	1074.3	466.3	10	10
Fireweed	885.4	384.3	11	11
Silver leaf nightshade	863.8	374.9	12	12
Asparagus weeds	675.5	293.2	13	13
Sea spurge	623.5	270.6	14	14
Hudson pear	541.9	235.2	15	15
Giant rat's tail grass	532.8	231.2	16	16

The next step in the assessment involved analysing the risk score as determined in model 1, 2 and 3 against the feasibility to control the weed, as illustrated in the matrix below for model 1 (this matrix was applied to

all three models). Weeds falling into ‘high risk’ and ‘high feasibility of control’ were considered priority targets (Figure 1).

Model 1		Feasibility of control			
		Low	Medium	High	
Risk criteria	Low	(0-172)	(0-4)	(5-9)	(10-14)
	Medium	(172-401)	Low	Low	Medium
	High	(401-528)	Medium	High	High

**Figure 1.** Interaction between ‘risk’ criteria and feasibility of control to determine priority for action. Numerical scores are presented as low, medium and high intervals.

The matrix analysis using scoring model 1 rated 12 weeds as HIGH and MEDIUM (4 and 8, respectively) and 4 weeds as Low, while model 2 resulted in 12 weeds rated as HIGH and 6 weeds as MEDIUM. No weeds were rated as LOW using model 2. In contrast, the matrix analysis using scoring model 3 rated none of the weeds as HIGH, 10 weeds as MEDIUM and 6 weeds as LOW. The same group of weeds that were rated using model 2 as HIGH and MEDIUM, were rated as MEDIUM and LOW using model 3.

In addition to the outcome of the matrix analyses, the AWC analysed feasibility of control using criteria derived from the National Environmental Biosecurity Response Agreement (NEBRA). The overall result was that control was considered achievable for each weed.

The AWC grouped closely related taxa under the same WoNS declaration (i.e. opuntoid cacti and brooms) resulting in the nominations being reduced to 14. Considering the result of the assessment process including resource requirements, the AWC endorsed 12 weeds as WoNS. The two lowest ranking nominees, giant rat’s tail (*S. pyramidalis*) and sea spurge (*E. paralias*) were not endorsed by the AWC as WoNS.

**CONCLUSION**

Twelve new WoNS were announced in April 2012 following a detailed assessment using the revised methodology (Lizzio *et al.* 2010) in consultation with experts in weed risk assessment and the AWC. The 16 nominations provided the first opportunity to test a set of weeds against this systematic prioritising process.

The technical assessment using the revised methodology showed consistent results in identifying the top ranking weeds and low ranking weeds, regardless of the scoring model used. For example, the same nine weeds appear in the top nine rankings in all three

models that were tested, whilst the bottom three weeds were consistently the lowest ranking weeds in all three models. Even weeds which were ranked in the middle range stayed within that group when different models were applied and only showed slight variation in their ranking. Overall, this shows that the revised methodology provides a robust framework to carry out a technical assessment of new WoNS candidates.

The process of assessing 16 WoNS candidates also showed that in addition to using the technical assessment based on the revised methodology, the consultation process which took into account the recommendations by weed experts, resource requirements and policy considerations were also a crucial part of the overall assessment of WoNS candidates.

Since the selection of the original 20 WoNS in 1999, this was the first assessment of new WoNS candidates. The revised methodology provided a simple, transparent and efficient process to carry out technical assessments and, in combination with the consultation process, resulted in new additions to Australia's list of 'worst weeds'. A total number of 32 WoNS are now recognised for their major adverse effects on Australia's primary production industries, the environment and social amenity.

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#### REFERENCES

- Lizzio, J., Richmond, L., Mewett, O., Hennecke, B., Baker, J. and Raphael, B. (2010). 'Methodology to prioritise Weeds of National Significance candidates' (Bureau of Rural Sciences, Canberra).
- Mewett, O., Richmond, L., Southwell, D., McCowen, S., Sands, A. and Hennecke, B. (2011). 'Assessing new Weeds of National Significance candidates'. (ABARES report prepared for the Australian Weeds Committee, Canberra).
- Thorpe, J.R. and Lynch, R. (2000). 'The Determination of Weeds of National Significance'. (National Weeds Strategy Executive Committee, Launceston).