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Cost of Weeds

Ranking Weeds of Importance to the Grazing Industry

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Abstract

Weeds impact the grazing industries in various ways through losses of pasture production, animal poisoning, downgrading of products and in some cases are barriers to trade. Because there are many species with potential to impact on the grazing and limited funding for management, it is necessary to identify where investment should be targeted for cost effective on ground action.

Several attempts have been made to prioritise weeds at a national scale and this project considers whether the Weeds of National Significance model (72 species) can be used for this purpose. The ranking derived from this model has been compared with Grice (2004) (119 species) who considered them on a regional basis for research priorities.

The analysis considered the economic costs, environmental and social impacts where data was available.

Twenty five species were ranked based on their cost to industry and these species were broadly consistent with those identified by Grice (2004). Many of the species considered had not reached their full extent of naturalization in Australia leading to the conclusion that preventing spread to uninfested areas is the most cost effective activity that can be undertaken by the grazing industries.

Executive summary

Weeds impact the grazing industries in various ways through losses of pasture production, animal poisoning, downgrading of products and in some cases are barriers to trade. Because there are many species with potential to impact on the grazing and limited funding for management, it is necessary to identify where investment should be targeted for cost effective on ground action.

The economic impact of weeds in Australia has been estimated to weeds cost Australia approximately $4,039 million annually. An estimation was made of the loss to specific industries, for livestock based industries the results were beef/veal $882.99m, lambs/mutton $283.30m, wool $588.20 and dairy $649.44m per annum.

Another significant economic issue for weed management is the return on investment for various management strategies, with a rate of return for prevention of invasion ranging from $38 to $100 return for every $1 invested through prevention of spread $8 for $1, to cost of control where the return is $4 for every $1 invested. Clearly preventing weed incursions is the most cost effective action that can be taken.

The prime purpose of this project is to develop a ranking for weeds of importance to Australia's grazing industries based on an analysis of economic datasets from the, Determination of Weeds of National Significance (WONS) framework undertaken in 1998 and compare the result with that compiled in a list of significant weeds to grazing industries of Australia as described by Grice (2004).

Options are discussed for refining the decision making process in order to target funding into the most cost effective on ground activities and provide recommendations on improvements to this methodology in order to increase its usefulness as a potential prioritisation tool for MLA's purposes.

The method used required the analysis of original 72 WONS weed species datasets based on the economic, environmental and social impacts for each species. The national economic impact was measured based on the cost of control for 25 weed species, which was a surrogate for pasture production losses, cost of other management practices to reduce spread and product sale losses resulting from weed contamination.

The twenty-five agricultural weeds from the WONS assessment that impact on grazing industries (1998 values), are ranked from highest to lowest as relative values, as absolute values are misleading due to data limitations.

The top ten species were blackberry, ragwort, gorse, Paterson's curse, serrated tussock, sicklepod, parthenium weed, prickly acacia, rubber vine, mesquite, The list includes seven of the top ten WONS.

The top five ranked weeds are all temperate weeds. This may reflect the increased return on investment from controlling weeds in higher rainfall areas and the more extensive distribution of weedy species in older/established agricultural areas.

One inescapable fact is that major weed species have the capability to invade a wide range of ecosystems from agriculture to the environment having significant social consequences. The top 5 to 10 species are invasive and potentially damaging across the entire landscape and therefore require a coordinated national approach to succeed in their management.

Recommendations to improve the methodology address the reliability of data and over estimation of feasibility of control and there were no national datasets that quantified animal production losses for specific weed species.

It has been possible to rank 25 weed species impacting on the grazing industries based on the cost of control drawn from the WONS data comprised of 72 species. However the results are imprecise and should only be used as indicative of importance to the grazing the industries.

When considering these weed species silver leaf nightshade should be included as it is usually addressed as a cropping problem, under estimating its potential to impact on grazing industries.

It would be tempting to call for detailed economic analysis to define the costs of weed species, but this would be expensive and may achieve little in the long run. The WoNS approach has shown what can be achieved by focusing effort in a coordinated manner.

Recommendation 1: When considering weed species of importance to the grazing industries, silver leaf nightshade should be included as it is usually considered a cropping problem, under estimating its potential to impact on grazing industries.

Recommendation 2: That when addressing WONS species that the extensive supporting information, particularly national management maps, environmental and social weighting in prioritisation, and best practice information be considered.

Recommendation 3: As preventing weed incursions is the most cost effective action that can be taken , that prevention of weed spread be incorporated into MLA biosecurity campaigns, pasture management programmes and livestock transport protocols.

Recommendation 4: That on behalf of industry, weed prioritisation is based around taking an asset protection approach and collectively tackle the factors degrading the asset of which weeds may represent only part of the threat.

Recommendation 5: That MLA consider the WONS species specific national priority action frameworks and research and development strategies available at www.weeds.org/WoNS/ when developing funding priorities.

Recommendation 6: That MLA incorporate the new WONS species into the research and development program when the species list becomes available, likely in 2012.

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1 Background - Section

1.1 Impact of weeds

The economic impact of weeds in Australia was studied by Sinden et al (2004), under the auspices of the CRC for Australian Weed Management and estimated that weeds cost Australia approximately $4,039 million annually. However a range of values from low $3,554m to a high of $4,532m was given because it was impossible to estimate a single value of any impacts at a given time. The vast majority of this cost was borne by agriculture with $112 million per year contributed from taxes towards the natural environment. The mean loss to agriculture was estimated at $3,927m of which 80% was borne by producers through reduced net incomes and the remaining 20% lost to consumers through higher prices.

This analysis under estimates the cost of weeds as the authors were unable to account for the loss of owner/operator labour, losses to industries where national estimation was not possible and the variability of national data and differing methodologies for their collection.

An estimation was made of the loss to specific industries, for livestock based industries the results were beef/veal $882.99m, lambs/mutton $283.30m, wool $588.20 and dairy $649.44m per annum.

Another significant economic issue for weed management is the return on investment for various management strategies, with a rate of return for prevention of invasion ranging from $38 (AEC Group 2002) to $100 (Dept of Primary Industries VIC 2009) return for every $1 invested through prevention of spread $8 for $1, to cost of control where the return is $4 for every $1 invested. Clearly preventing weed incursions is the most cost effective action that can be taken.

Contrary to what may be thought, there are many weed species that have not reached the full extent of their range in Australia and there is merit in reducing their spread sooner rather than later. Another consideration is that for our less intensive grazing industries, the cost of controlling weeds in one year can be greater than the land value making it uneconomic to control them. This results in production being uneconomic.

The rationale for Weeds of National Significance(WONS) is to apply coordinated actions against major weed species across Australia to prevent them from reaching their full range and managing their impacts, and where there is benefit from nationally coordinated action. Their management is supported by all states and territories and the Australian Government.

2 Project objectives - Section

2.1 Objective 1

The prime purpose of this project is to develop a ranking for weeds of importance to Australia's grazing industries based on an analysis of economic datasets from the National Weeds Strategy Executive Committees, Determination of Weeds of National Significance (WONS) framework undertaken in 1998 (Thorp and Lynch 2002).

2.2 Objective 2

To compare the final ranking above to the list of significant weeds to grazing industries of Australia as described by Grice (2004).

2.3 Objective 3

To discuss some options for refining the decision making process in order to target funding into the most cost effective activities

2.4 Objective 4

To provide recommendations on improvements to this methodology in order to increase its usefulness as a potential prioritisation tool for MLA's purposes.

3 Methodology - Section

3.1 Weeds of National significance

3.1.1 Process

In May 1998, State and Territory Governments agreed on an approach to determine WONS. An assessment of WONS included four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socioeconomic and environmental values

Under the socioeconomic and environmental values criterion, three separate attributes were examined:

- Economic data for agricultural and forestry (primary industry) weeds
- Environmental values
- Social impacts

Seventy-one weeds were nominated by the states and territories to be assessed under the WONS framework*.

3.1.2 WONS economic data

While most states had conducted economic analyses on some of their key agricultural weeds, no standard format existed for deriving estimated costs to production on a national basis. As a consequence, there was no readily available economic data at a national level that would allow a dollar value to be easily obtained which was comparable across states. There was even less detailed economic analysis for forestry weeds.

The aim was to develop a methodology that would allow a uniform approach to be undertaken across the jurisdictions. Under the WONS process, the actual dollar value for a weed's impact on primary industry production was less important than developing a method which would allow comparative analysis across states based on weed species relativities. Given the time constraints associated with the WONS assessment, a practical and cost-effective method

* States and territories nominated 73 individual weeds species and the group of herbicide-resistant weeds to be assessed. This was reduced to 71 species by combining *Sporobulus natalensis* with *S. Pyramidalis* and *Sena obtusifolia* with *S. tora*. The WONS framework was unsuitable for prioritising multi-species problems such as herbicide-resistant weeds and this group was excluded from the assessment.

needed to be developed that could be undertaken relatively quickly by each state. The method also needed to be applicable for both agricultural and forestry operations.

Focussing only on the up-front management costs of controlling a weed provided the simplest data solution. At that time, the availability, understanding and use of gross margins was widespread in agriculture with the information published and readily available across different agricultural industries and regions. Similar economic information was also available for forestry operations. Such an approach would allow quick estimates of the economic impact of a weed on a representative production system for particular industries and regions to be made. For pastoral industries, estimates needed to be made at the regional level.

The management costs to be considered were:
- Costs and application of herbicides
- Mechanical practices such as pulling of woody weeds, inter-row tillage of weeds
- Targeted grazing

The costs of weed control were to be considered under best management practices – activities undertaken at the correct time using appropriate resources with sound commercial control results.

The calculations were to ignore:
- General tillage operations
- Yield/production losses
- Product contamination

3.1.3 Calculation of WONS economic data

Economic data for primary industry weeds were provided by the nominating state(s) using the following methodology:
- Identify the industries/enterprises that a weed impacts upon
- The region(s) to which the figures apply
- The average area of the particular enterprise (using 10 year average figures)
- An estimation of the average proportion of area treated (sprayed/mechanical operation) for that region under best management practices
- The herbicide(s) used and method of application
- The mechanical operations undertaken
- The average cost of the herbicide(s)
- The average cost of application(s)
- The average mechanical and other costs
- For each herbicide treatment (herbicide plus application costs) apply an appropriate discount factor where a herbicide applied targets more than the specified weed as follows:

Discount Factor	**Herbicides applied under the following circumstances**
1	WONS species weed specific herbicide or when the herbicide is applied to only control the weed in question
0.75	Broad spectrum herbicides when the weed in question is the dominant weed targeted
0.5	Broad spectrum and non-specific herbicides where the weed in question is one of the major weeds targeted

0.25	Broad spectrum and non-specific herbicides where the weed in question is not the major weed targeted

- Calculate an average total control cost for the weed, by industry/enterprise. Only applies to average annual area treated and not the control cost if the total area was treated
- Where possible, provide regional break ups

Despite guidelines outlining the requirements, the economic data received from the states varied substantially in quality and application of the methodology. In some cases different industry figures were combined and not listed separately, and in other instances, environmental costs were included. To improve comparability, the data was reassessed and refined as required.

3.2 WONS social impact data

Weed reference panels discussed a weed's social impact with positive and negative traits recorded for each weed focussing on information not specifically covered by other WONS criteria. This information was then subjectively rated as nil, low, medium or high, and given a score of zero through to three for a high rating, depending on the number and severity of negative versus positive traits.

4 Results and discussion - Section

4.1 WONS economic data results

Data was provided on the economic cost to agriculture only for sixteen weeds, to forestry only for six weeds and to primary industry (agriculture and forestry) for thirteen weeds. In addition some states provided economic data for environmental weeds controlled by local councils or in national/state parks. This data was not used as environmental impacts were assessed separately. Appendix 1. Contains a table of WONS Economic Costs for Primary Industry Weeds.

The costs attributed to agricultural and forestry weeds ranged from $0 to more than $26m. The largest value (blackberry) was an extreme outlier, being 3.5 times the value of the next nearest species (Paterson's curse).

Table 1, reproduced from Thorp and Lynch (2000) summarises the estimated costs of the thirty-five primary industry weeds for which economic data was provided, broken down into four classes: less than or equal to $100,000; $100,001 to $1,000,000; $1,000,001 to $5,000,000; and greater than $5,000,000.

Table 1. WONS Economic cost groupings of primary industry weeds.

Less than or equal to $100,000	$100,001 to $1,000,000	$1,000,001 to $5,000,000	Greater than $5,000,000
African love grass	African boxthorn	giant Parramatta grass	blackberry
bellyache bush	Bathurst burr	giant rat's tail grass	gorse
bitou bush/boneseed	fireweed	lantana	Paterson's curse
broom	mimosa	mesquite	
broomrape	Noogoora burr	onopordum thistles	
cat's claw creeper	Parkinsonia	parthenium weed	
golden dodder	willows	prickly acacia	
hyptis		ragwort	
madeira vine		rubber vine	
narrow leaf cotton bush		St John's wort	
pampas grass		Scotch broom	
		serrated tussock	
		sicklepod	
		silver leaf nightshade	

In the WONS assessment, the economic data was scaled to one to create an economic index using the second highest value weed, Paterson's curse, with the economic value for blackberry being viewed as an extreme outlier.

4.1.1 WONS economic data limitations

The WONS economic data methodology ignored opportunity costs resulting from lost production due to the impact of a weed and any other management practices that were undertaken to reduce the spread of a weed or contamination to produce, apart from those direct weed control costs listed above. Wider industry benefits, social costs* and future impacts due to potential area for spread were ignored and the data obtained represented only an average direct economic expense of controlling the weed.

The approach tended to favour the more intensive industries. In the case of pastoral industries, returns per hectare are low and management decisions on direct weed control must take into account expected likely returns and possible future losses due to weed spread. In many cases, the average total cost of control for a weed in pastoral industries was unknown and no overall figure was provided by the relevant state.

Data provided was quite variable across the states. This reflected the lack of accurate weed distribution data at the time combined with how widely each state consulted across regional and industry personnel to obtain detailed information, all of which impacted on the accuracy of the data.

* Social impact data was considered separately under the WONS process and is discussed in section 4.3 of the report.

In addition, economic data was not provided for all agricultural weeds. Each state tended to focus on what they considered to be their highest priority agricultural weeds and/or those weeds for which information was more readily available and only provided the data for those weeds. Data was also provided only for weeds nominated by a state, even though a weed may have been present and had an economic cost in other states.

Due to the variability in applying the methodology and embedding of some environmental costs in the data, it was necessary to use a degree of judgement in refining the data. As a result of these data limitations along with the main objective on ensuring a degree of relativity between the data for comparative purposes across states, the economic values should not be viewed as actual dollar amounts.

To reflect the reliability of the economic data compared to other criteria used in the WONS rating system, the economic index was given a maximum weighting of 0.25. The more reliable data from the weed reference panels* from which invasiveness and impact indices were developed were both given maximum weightings of one.

4.1.2 Refinements to this analysis

The original economic data files received from the states were re-examined. The Victorian file could not be located and the economic data for that state was derived from the total data file. The following table lists which states provided economic data for the twenty-nine agricultural weeds.

Table 2. Agricultural weed economic data received by state

Common Name	SA	NSW	QLD	WA	TAS	VIC*	NT†
African boxthorn	✓						
African love grass	✓						
Bathurst burr	✓	✓		✓			
bellyache bush							✓
blackberry	✓	✓			✓	✓	
broomrape (all spp.)	✓						
fireweed			✓				
giant Parramatta grass		✓					
giant rat's tail grass		✓	✓				
golden dodder	✓						
gorse	✓				✓	✓	
hyptis							✓
lantana		✓					
mesquite			✓	✓			
mimosa							✓
narrow leafed cotton bush				✓			

* There were three expert weed reference panels used in the WONS process - a temperate, sub-tropical and tropical panel. The panel members discussed and compiled information from over 2500 pages of questionnaires.

Noogoora burr				✓			
onopordum thistles		✓				✓	
Parkinsonia			✓				✓
parthenium weed			✓				
Paterson's curse	✓	✓				✓	
prickly acacia			✓				
ragwort					✓		
rubber vine		✓	✓				
serrated tussock		✓			✓	✓	
sicklepod			✓				✓
silver leaf nightshade	✓						
St John's wort		✓					
willows					✓		

∗ - Economic data derived from total data as original file could not be located.

† - Economic impact information was provided for the following weeds, but average area treated was unknown and no economic cost of control data could be derived: athel pine, grader grass, Mexican poppy, mission grass, Noogoora burr, sida spp. and snake weed.

The economic data for four weeds related to non-grazing industries only and were removed from the final analysis. In addition, the value for willows was for its impact on irrigation channels in irrigated cropping and grazing industries in Tasmania. This was considered to be outside of the scope for weeds of importance to the grazing industry and willows was also removed from the final analysis. The five weeds removed and their WONS economic data are listed in the following table. It should be noted that three of those weeds, African love grass, broomrape (all spp.) and silver leaf nightshade were considered less important weeds for the grazing industries in 1998 when the WoNS analysis was undertaken(Grice 2004 defines silver leaf nightshade as an emerging problem for grazing).

Table 3. Non-grazing industry agricultural weed economic data

Common name	Economic cost	State	Industry
African love grass	$38000	SA	Small seed and hay production
broomrape (all spp.)	$1000	SA	Specific eradication program for branched broomrape
golden dodder	$1500	SA	Lucerne for hay production
silver leaf nightshade	$1700000	SA	Dry land cropping (NOTE that this species has emerged as a problem for the grazing industry since the WONS analysis was undertaken in1998)
willows	$270000	TAS	Irrigated cropping and grazing

Due to the way that economic data was provided, for seven other agricultural weeds of importance to grazing industries, it was not possible to remove non-grazing industry and other costs as detailed in the following table.

Table 4. Non-grazing industry costs included in the WONS economic data

Common name	State	Non-grazing industry and other

		costs included in the WONS economic data
Bathurst burr	NSW	Environmental costs
fireweed	QLD	Dairy industry
giant rat's tail grass	QLD	Dairy industry
lantana	NSW	Environmental costs
parthenium weed	QLD	Cropping industry
ragwort	TAS	Dairy industry
sicklepod	QLD	Sugarcane industry and forestry

4.1.3 Results from the economic analysis

Table 5 lists the economic data for the remaining twenty-five agricultural weeds from the WONS assessment that impact on grazing industries (1998 values), ranked from highest to lowest. As previously discussed under the data limitations section, the data represented relative values at the time and not actual national economic costs of controlling each of the weeds.

The list includes seven of the top ten WONS. The three other top ten WONS are environmental/aquatic weeds: bitou bush/boneseed; hymenachne; and salvinia. In the case of hymenachne, this is considered a valuable (introduced) fodder plant for cattle in northern Australia and therefore economic data for its control (sugar cane) as an agricultural weed was offset by its production value and would not be expected to have a high overall cost to agriculture.

The top five ranked weeds are all temperate weeds. This may reflect the increased return on investment from controlling weeds in higher rainfall areas and the more extensive distribution of weedy species in older/established agricultural areas.

4.1.4 Comparison of WONS ranking with lists created by Grice(2004)

The weed ranking based on economic data was also compared with the two lists developed by Grice (2004): a list of 119 weed species considered relevant to Australian grazing lands; and a list of forty-eight species considered especially significant based on eight regional reviews with information for Tasmania provided during the post-workshop review process (see table 7) South Australia was not included in this analysis. A count was also made of the number of regions in which a weed was considered significant.

In the Grice report, weeds were not ranked in terms of their overall national importance and therefore a direct comparison between the two systems is not possible. In addition, the report had a different focus with one of the terms of reference being to determine research and development opportunities and priorities for weeds considered significant to grazing industries and on the basis of feasibility of success.

Only three of the weeds from the economic data ranked list: ragwort; giant Parramatta grass; and narrow leafed cotton bush, were not considered significant weeds to grazing industries by Grice. Both ragwort and giant Parramatta grass were included in the Grice weed relevant list.

Table 5. Economic data ranking for weeds of importance to Australia's grazing industries

Economic data ranking (Thorp and Lynch 2000)	**WONS ranking** (Thorp and Lynch 2000)	**Common name**	**Economic data (1998 value)** (Thorp and Lynch 2000)	**State data supplied**(Thorp and Lynch 2000)	**Weed relevant list lı** (Grice 2004)	**Weed significant list lı** (Grice 2004)	**No of regions (max. 9)** †† (Grice 2004)
1	3	blackberry	$22.5m	NSW, SA, TAS, VIC	✓	✓	3
2	55	ragwort*	$3.95m	TAS	✓	X	-
3	18	gorse	$3.61m	SA, TAS, VIC	✓	✓	1
4	32	Paterson's curse	$3.42	NSW, SA, VIC	✓	✓	2
5	15	serrated tussock	$2.8m	NSW, TAS, VIC	✓	✓	3
6	30	Sicklepod†	$2.595m	QLD, NT	✓	✓	2
7	16	parthenium weed‡	$2.4m	QLD	✓	✓	3
8	7	prickly acacia	$2.2m	QLD	✓	✓	2
9	5	rubber vine	$2.1m	NSW, QLD	✓	✓	1
10	2	mesquite	$1.72m	QLD, WA	✓	✓	5
11	52	onopordum thistles	$1.71m	NSW, VIC	✓#	✓#	4
12	39	Silver leaf nightshade	$1.7m	SA	✓	✓	4
13	48	giant Parramatta grass	$1.47m	NSW	✓	X	-
14	4	lantana§	$1.269m	NSW	✓	✓	3
15	42	St John's wort	$1.17m	NSW	✓	✓	1
16	58	giant rat's tail grass*	$1.005m	NSW, QLD	✓	✓**	4
17	24	African boxthorn	$680,000	SA	✓	✓	1
18	10	mimosa	$636,000	NT	✓	✓	2
19	40	Bathurst	$575,000	NSW,	✓	✓	2

		burr§		SA, WA			
20	66	Fireweed*	$525,000	QLD	✓	✓	1
21	1	Parkinsonia	$300,000	QLD, NT	✓	✓	3
22	28	Noogoora burr	$280,000	WA	✓	✓	2
23	22	hyptis	$24,000	NT	✓	✓	1
24	63	narrow leafed cotton bush	$10,000	WA	X	X	-
	21	bellyache bush	$1,560	NT	✓	✓	3

* - includes dairy industry costs.
† - includes sugarcane industry and forestry costs in Queensland.
‡ - costs predominately for the cropping industry.
§ - includes some environmental costs.
Iı - from Grice (2004).
-Grice 2004 includes more than onopordum thistles.
** - Grice 2004 includes more than giant rat's tail grass.
†† - Grice 2004 weed significant list derived from nine regional reviews. South Australia was not included in the regional reviews.

4.2 WONS environmental data results

Under the WONS process, the environmental impact of a weed was considered by combining a number of environmental indicators covering biodiversity and conservation factors using information supplied by the states, by the WONS authors (Thorp and Lynch 2002) and the weed reference panels as outlined below. Appendix 2 contains the guidelines for the environmental component .

Biodiversity indicators covering the number of threatened species and threatened conservation areas impacted by a weed were supplied by the states for their nominated weed species. This data was converted to a proportion of the maximum numbers possible in each state. The proportion was then scaled to one for the highest value to create an index for each indicator.

Conservation indicators consisted of the number of Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway and Creswell 1995) regions infested by a weed species and the monoculture potential of a weed.

Australia is divided into 80 IBRA regions. IBRA regions were used as they more closely approximated plant species richness under threat, a weed's ability to invade different ecosystems and adjusted for scale of the ecosystems which vary in size by several orders of magnitude. While each IBRA region is considered of equal value, they vary in size with the smaller regions within 300 kilometres of the coastline and the larger regions mostly in the arid or semi-arid areas. The IBRA infestation count was made from weed distribution maps and the scores were scaled to one for the highest value to create an index.

Monoculture potential was used to assess the level of plant competition imposed on a plant community resulting from invasion by a weed. Responses to the first three questions from the impacts questionnaire* were used to inform the weed reference panels in developing a 1-5

* The three questions were: how long does an infestation of the weed last; what reduction in the amount of the desired vegetation is caused by the weed; and does the weed limit the recruitment of desired vegetation?

monoculture score for each weed. The score was scaled to one for the highest value to create an index.

4.2.1 WONS environmental data for weeds of importance to Australia's grazing industries

Each of the WONS environmental indicators had an equal weighting and combining the four indices allows a rating for overall environmental impact of a weed to be determined as shown in the following table (maximum possible score of four).

The top five environmental ranked weeds include the top four economic data ranked weeds. The exception is ragwort. Noogoora burr ranks in the environmental top five, but does not rank highly in the economic weeds because it is effectively biologically controlled.

Table 6. WONS environmental data and ranking for weeds of importance to Australia's grazing industries

Economic data ranking	WONS environmental ranking	Common name	WONS environmental score
1	1	blackberry	3.1490
2	17	ragwort	1.4048
3	4	gorse	2.0283
4	2	Paterson's curse	2.5610
5	3	serrated tussock	2.1624
6	19	Sicklepod	1.3690
7	16	parthenium weed	1.4697
8	20	prickly acacia	1.2860
9	10	rubber vine	1.6125
10	15	mesquite	1.5012
11	22	onopordum thistles	1.1663
12	21	Silver leaf nightshade	1.2051
13	25	giant Parramatta grass	0.9377
14	7	lantana	1.7647
15	11	St John's wort	1.5845
16	24	giant rat's tail grass	0.9622
17	6	African boxthorn	1.8366
18	12	mimosa	1.5245
19	9	Bathurst burr§	1.6752
20	23	Fireweed	0.9805
21	8	Parkinsonia	1.7543
22	5	Noogoora burr	2.0218
23	13	hyptis	1.5145
24	14	narrow leafed cotton bush	1.5118
25	18	bellyache bush	1.3963

4.3 WONS social impact data for weeds of importance to Australia's grazing industries

Of the twenty-five ranked weeds of importance to the grazing industry, three were assessed as having a medium social impact, fourteen were rated as low and seven as nil. Under the WONS process, no weed achieved a high rating. Table 7 lists the weeds' social impact rating and the positive and negative traits as recorded from the weed reference panel discussions.

Table 7. WONS social impact data for weeds of importance to Australia's grazing industries

Eco-nomic data ranking	Common name	Social impact rating *	WONS Ref panel †	Negative social impact traits	Positive social impact traits
1	blackberry	M	Te	Fireloads/access to amenities	edible fruits
2	ragwort	L	Te	Land values/contact dermatitis	Chinese herbal
3	gorse	L	Te	Access/fireloads	beekeeping
4	Paterson's curse	L	Te	Allergic reactions/ contact dermatitis	beekeeping
5	serrated tussock	L	Te	Decrease productivity/ fireloads	
6	Sicklepod	N	Tr		
7	parthenium weed	M	St, Tr	Major allergic problems on contact/taints milk	
8	prickly acacia	L	Tr	stock movement/ mustering	fodder/shelter
9	rubber vine	L	Tr	Access to creeks/ aesthetics/tourism	
10	mesquite	L	St, Tr	spiny/amenity value	Shade/fodder/firewood/ ornamental/land reclamation
11	onopordum thistles	N	Te	Stocking capacity/land values	
12	Silver leaf nightshade	L	St, Te	Possible child poisoning	
13	giant Parramatta grass	L	St	fireloads	
14	lantana	L	St, Tr	fireloads/ access	Ornamental/ prevents erosion
15	St John's wort	N	Te	stock losses	Herb/oil extraction
16	giant rat's tail grass	N	St		

17	African boxthorn	L	Te, St	thorns/access	protects birds from predators
18	mimosa	M	Tr	pines/access/amenity/ affects Indigenous lifestyles	
19	Bathurst burr §	L	Te, St	shearing/animal discomfort	
20	Fireweed	N	St		
21	Parkinsonia	L	St, Tr	blocking rivers/ flooding	Export of seedlings to Saudi
22	Noogoora burr	L	Te, St, Tr	shearing/animal discomfort/host for golden dodder	
23	hyptis	N	Tr		
24	narrow leafed cotton bush	L	St	toxic to humans\stock(?)\ productivity losses(?)	
25	bellyache bush	N	Tr	toxic	oil extraction

* N - nil, L – low, M - medium, H - high.
† Te - WONS temperate weed reference panel, St - WONS sub-tropical weed reference panel, Tr - WONS tropical weed reference panel

4.4 Combining WONS economic, environmental and social impact data for weeds of importance to Australia's grazing industries

Under the WONS assessment process, economic, environmental and social impact data were weighted equally. Using the same approach, the following table compares the ranking of twenty-five weeds using economic data with the combined economic, environmental and social impact data.

While there is some reordering, there is only one change to the top ten weeds with mimosa replacing sicklepod (see table 8). This is a result of combining the scores where to reach the top of the list a species must score highly on each of the criteria and mimosa scores highly for social impacts.

One inescapable fact is that major weed species have the capability to invade a wide range of ecosystems from agriculture to environmental having significant social consequences. The top 5 to 10 species are invasive and potentially damaging across the entire landscape and therefore require a coordinated national approach to succeed in their management.

Table 8. Comparison of economic data ranking with combined economic, environmental and social impact data ranking

Economic data ranking	EcoEnvirSoc ranking	Common name	EcoEnvirSoc score (max. 3)
1	1	blackberry	2.6668
2	4	ragwort	1.7793
3	3	gorse	1.8912

4	2	Paterson's curse	2.0123
5	6	serrated tussock	1.7288
6	12	Sicklepod	1.0917
7	5	parthenium weed	1.7411
8	9	prickly acacia	1.2985
9	7	rubber vine	1.3769
10	10	mesquite	1.2454
11	19	onopordum thistles	0.8033
12	21	Silver leaf nightshade	0.6520
13	16	giant Parramatta grass	1.0031
14	11	lantana	1.2149
15	20	St John's wort	0.7994
16	22	giant rat's tail grass	0.5600
17	13	African boxthorn	1.0886
18	8	mimosa	1.3119
19	15	Bathurst burr§	1.0107
20	24	Fireweed	0.4443
21	17	Parkinsonia	0.9662
22	14	Noogoora burr	1.0461
23	23	hyptis	0.4870
24	18	narrow leafed cotton bush	0.8158
25	25	bellyache bush	0.4438

5 Success in achieving objectives – Section

The ranking of weed species is a challenging task as many of the aspects considered lack objective measures and or reliable national datasets. Consequently it is possible to make some recommendations for an improved methodology, but it will always include a level of subjectivity.

5.1 Recommendations to improve the methodology

5.1.1 Unreliability of economic data

Whilst the determination of WoNS process was fit for purpose and enabled the identification of Australia's 20 most serious weeds, we have reservations about the robustness of the economic measures. Jurisdictions had varying methods for valuing the cost of control and no data was presented for the cost of lost production and downgraded production, a more direct economic measure. This lack of national datasets was a problem in 1998 and nothing has changed to date. New species are currently being assessed as additional WoNS and economic datasets will need to be created for this purpose

5.1.2 Feasibility of control

It is our opinion that the estimated levels of control were overstated for some species because we could not reconcile the level of control with the national chemical use figure which was insufficient to achieve the level of management claimed. Again this data is usually not available

and is confounded by chemicals having multiple uses. This may be a reflection of feasibility of control resulting in lower use for economic reasons.

Another aspect of feasibility of control is the practicality of making a long term difference across industries for a species. For example making Noogoora and Bathurst burr WoNS would have achieved little, as successful biological controls were already in operation. For other species such as Cabomba there is currently no practical method of control. Therefore the most effective approach may be research and development to identify management methods.

It would be tempting to call for detailed economic analysis to define the costs of weed species, but this would be expensive and may achieve little in the long run. The WoNS approach has shown what can be achieved by focusing effort in a coordinated manner. The top twenty species is probably not the perfect priority list, but twenty major weeds are being prevented from increasing their range with the attendant avoidance of management costs.

For some species economic control may not be possible and in this instance preventing spread into free areas may be the only option available. These examples highlight the value in knowing the weed species, understanding what drives the invasion and what must be done to disrupt/halt the invasion process. The WoNS strategies provide a well thought out approach to managing a species on a national scale and provide priorities for on ground action.

So far we have addressed species, but for an industry a more valuable approach would be to take an asset approach and collectively tackle the factors degrading the asset of which weeds may represent only part of the threat. For example eradication of an exotic disease will nearly always take a higher management priority than weed invasion.

5.1.3 Additional factors in weed prioritisation

Thorp and Lynch (2000) include an assessment of environment and social factors in the development of the priority index. It is recommended that these dimensions are considered in prioritising weed issues for the livestock industry. This should include taking an asset protection approach to the environmental in order to constrain on ground action to the resources available.

Likewise, besides simply an economic assessment, consideration should be given to recognition of other investments. This is not necessarily at the specific weed level, but more strategically. The priority weeds listed in this report are well represented on the WONS listing where significant on ground action has already occurred. MLA should not simply accept investing in these weeds as they are being supported by other initiatives. A greater return on investment for MLA may be to invest in weeds at the early stages of invasion, particularly if a species is moving from eradication to the management phase. This may include in a more direct focus on emerging weeds as described by Grice 2004, preventing a new future candidate for WONS status.

5.2 Comparison with the final ranking of significant weeds to grazing industries of Australia as described by Grice (2004)

5.2.1 Limitations of report comparison

In the Grice report, weeds were not ranked in terms of their overall national importance and therefore a direct comparison between the two systems is not possible. In addition, the report had a different focus with one of the terms of reference being to determine research and development opportunities and priorities for weeds considered significant to grazing industries and on the basis of feasibility of success. Whereas the WONS analysis is based on national impact, invasiveness and need for coordination.

Only three of the weeds from the economic data ranked list: ragwort; giant Parramatta grass; and narrow leafed cotton bush, were not considered significant weeds to grazing industries by Grice. Both ragwort and giant Parramatta grass were included in the Grice weed relevant list.

5.3 Silver leaf nightshade a special case

This species was included in the 1998 WONS candidate list, but was only identified as causing economic losses in cropping systems. There was no mention of problems impacting the grazing industries. Therefore there was no economic data which justified its inclusion in the core analysis. However as it is a significant weed of dry land cropping, it has emerged as a weed of grazing systems over the past 10 years and can be expected to have an increased impact in the future. Similarly this was highlighted by Grice(2004) as a species problem of the cropping/pasture and perennial pasture zones requiring a systems approach for its management.

Based on these assumptions, the species should be considered a high priority for management action as its impact will increase into the future.

6 Impact on meat and livestock industry – Now and in five years time - Section

6.1 Heading

The immediate benefit to the livestock industry of this work is to assist with prioritisation of weed investments. The report has highlight the economic priority based on old, yet most reliable data sets that exist.

This paper should be instrumental in raising weeds as an important management issue with livestock producers, as there are numerous on ground actions that could be adopted to prevent weed spread. These result in savings that flow directly to producer's bottom line. Unfortunately future avoided costs are often over looked. But weed problems are often insidious and frequently producers realise the cost of the problem too late, with weeds threatening their economic viability.

There are large parts of Australia which are generally free of serious, threatening weeds (Kimberly, Northern Territory, Northern Queensland) where the potential cost of controlling weed invasions exceeds property land values. Therefore it would be prudent for MLA to consider targeted weed spread prevention programmes, early detection, vehicle wash down, limiting contaminated stock movements (where external and or internal seed contamination is suspected), vendor declarations for stock and fodder and voluntary property, district and regional farm hygiene(biosecurity) programmes. Prevention is far better than cure, with a return on investment of from $36 to $100 for every dollar spent.

It is important to note that the 2002 report by Thorp and Lynch included the environmental and social dimension in the assessment. Consideration of these two dimensions should also be addressed in weed prioritisation, as both directly impact on the sustainability of the production system.

We anticipate that climate change will impact weed distributions in various ways, some positive and others negative, with little impact on some species. But it would be prudent for MLA to consider current and future modelling with a view to seeking out future weed management opportunities.

The benefits in the longer term from weed prioritisation will enable more effective conduct of RD&E from funding of all sources.

7 Conclusions and recommendations - Section

7.1 Weed species important to the grazing industries

It has been possible to rank 25 weed species impacting on the grazing industries based on the cost of control drawn from the WONS data comprised of 72 species. However the results are imprecise and should only be used as indicative of importance to the grazing the industries.

Recommendation 1: When considering weed species of importance to the grazing industries, silver leaf nightshade should be included as it is usually considered a cropping problem, under estimating its potential to impact on grazing industries.

7.2 Use an integrated asset approach

So far we have addressed species, but for an industry a more valuable approach would be to take an asset approach and collectively tackle the factors degrading the asset of which weeds may represent only part of the threat. For example eradication of an exotic disease will nearly always take a higher management priority than weed invasion.

Recommendation 2: Weed management should be addressed as an integral part of sustainable grazing production systems where a weed focus is accepted as core business for producers.

7.3 WONS species supported by management maps

The 20 WONS have received preferential management for approximately 10 years and are supported by national strategies, management maps and best practice information that is not available for most of the other species(WONS information is available www.weeds.org.au). This enables targeted on ground messages to be formulated depending on weed presence or absence and invasion risk.

Recommendation 3: That when addressing WONS species that the extensive supporting information, particularly national management maps and best practice information be considered.

7.4 Preventing spread

The majority of the 25 species **have not** reached their full extent of naturalization in Australia and consequently warrant applying prevention of spread actions to unaffected areas of the landscape. This is particularly important for rangeland species where the annual cost of control may exceed land value. The prevention of spread message could be incorporated into biosecurity campaigns, animal transport protocols and pasture management programmes.

Recommendation 4: That prevention of weed spread be incorporated into MLA biosecurity campaigns, pasture management programmes and livestock transport protocols.

7.5 Research priorities are available for WONS species.

Every WONS species has a national priority action framework to guide investment and funding applicants toward the most effective work that can be undertaken in managing the species. Some of these are research activities and for some species have developed stand alone research and development strategies.

Recommendation 5: That MLA consider the WONS species specific national priority action frameworks and research and development strategies available at www.weeds.org/WoNS/ when developing funding priorities.

7.6 New WONS species

At the time of writing (April 2011) the approval of more WONS species was being considered and some of these species will be of significance to the grazing industry. This will encourage a national focus to preventing their spread, controlling outlier infestations and providing best management advice for on ground control.

Recommendation 6: That MLA incorporate the new WONS species into the research and development program when the species list becomes available.

8 Bibliography

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9 Appendices

9.1 Appendix 1 Table of WONS Economic Costs for Primary Industry Weeds.

Scientific Name	Common Name	Agriculture	Forestry	Total
Acacia nilotica	Prickly acacia	$2,200,000	-	$2,200,000
Anredera cordifolia	Madeira vine	-	$5,000	$5,000
Chrysanthemoides monilifera	Bitou bush / boneseed	-	$6,800	$6,800
Cortaderia spp.	Pampas grass	-	$100,000	$100,000
Cryptostegia grandiflora	Rubber vine	$2,100,000	-	$2,100,000
Cuscuta campestris	Golden dodder	$1,500	$9,000	$10,500
Cytisus scoparius	Scotch broom	-	$1,040,000	$1,040,000
Echium plantagineum	Paterson's curse	$3,420,000	$4,050,000	$7,470,000
Eragostis curvula	African love grass	$38,000	-	$38,000
Genista monspessulana	Montpellier broom	-	$45,000	$45,000
Gomphocarpus fruiticosus	Narrow leaf cotton bush	$10,000	-	$10,000
Hypericum perforatum	St John's wort	$1,170,000	$3,000	$1,173,000
Hytis suaveolens	Hytis	$24,000	-	$24,000
Jatropha gossypifolia	Bellyache bush	$1,560	-	$1,560
Lantana camara	Lantana	$1,269,000	$777,000	$2,046,000
Lycium ferocissimum	African boxthorn	$680,000	-	$680,000
Macfadyena unguis-cati	Cat's claw creeper	-	$32,000	$32,000
Mimosa pigra	Mimosa	$636,000	-	$636,000
Nassella trichotoma	Serrated tussock	$2,800,000	$32,000	$2,832,000
Onopordum spp.	Onopordum thistles	$1,710,000	$82,000	$1,792,000
Orabanche spp.	Broomrape (all spp.)	$1,000	-	$1,000
Parkinsonia aculeata	Parkinsonia	$300,000	-	$300,000
Parthenium hysterophorus	Parthenium	$2,400,000	-	$2,400,000
Prosopis spp.	Mesquites	$1,720,000	-	$1,720,000
Rubus fructicosus agg.	Blackberry	$22,500,000	$3,600,000	$26,100,000
Salix spp.	Willows	$270,000	$16,000	$286,000
Senecio jacobaea	Ragwort	$3,950,000	-	$3,950,000
Senecio madagascariensis	Fireweed	$525,000	-	$525,000
Senna obtusifolia/ tora	Sicklepod	$2,595,000	$1,000	$2,596,000
Solanum elaeagnlfolium	Silver leaf nightshade	$1,700,000	-	$1,700,000
Sporobolus indicus var major	Giant parramatta grass	$1,470,000	$15,000	$1,485,000
Sporobolus natalensis/pyr.	Giant rat's tail grass	$1,005,000	$58,000	$1,063,000
Ulex europaeus	Gorse	$3,610,000	$3,384,000	$6,994,000

Xanthium occidentale	Noogoora burr	$280,000	$9,000	$289,000
Xanthium spinosum	Bathurst burr	$575,000		$575,000

9.2 Appendix 2 Guidelines for the Environmental Component

9.2.1 Introduction

As part of the Weeds of National Significance (WONS) SCC out of session paper, a number of criteria were outlined, which would be used to select WONS. The environmental values attributes were described (Annex I), and it was agreed that all member states would provide data on species and special conservation areas threatened by weeds.

This paper describes the data that are required and the boundaries for those data. Emphasis has been placed on developing a practical system which suites the purpose of collection, with minimal effort on the part of SCC members.

9.2.2 Scope of Data

A State or Territory is only requested to provide data for environmental weeds nominated by their jurisdiction. Annex II lists the weed species nominated by member states, of which, only a proportion are environmental weeds.

Do not provide data for weeds not nominated by your jurisdiction.

9.2.3 Conservation Indicators

The two indicators under this section, weed infested IBRA regions and monoculture potential, will be obtained separately from other sources.

The weed infested IBRA regions will be derived from species distribution maps being prepared by SCARM members, who are expected to consult with their respective conservation agencies.

Monoculture potential will be derived from the scientific panels, where this question forms part of the invasiveness and impacts criteria.

9.2.4 Biodiversity Indicator

Two aspects comprise this indicator, the number of threatened species and threatened special conservation areas.

9.2.5 Number of Threatened Species

The number of species threatened (includes Critically Endangered, Endangered and Vulnerable in accordance with IUCN definitions) by each environmental weed nominated by the State or Territory.

The data required are the number of above threatened species by each environmental weed species for the jurisdiction in question. Species counts should be supported by threatened species lists, which may be as simple as a printed list, with the affected species highlighted.

9.2.6 Threatened Special Conservation Areas

In response to suggestions made by SCC members, the list of special conservation areas has been expanded to include those identified under the RFA process, as well as other categories described below.

For each nominated environmental weed species, count the number of areas threatened (an area of land may only be counted once per weed species). Areas, which may be included, are;

- Listed Threatened Plant Communities
- National Estate Listings
- World Heritage Areas
- Ramsar Wetlands
- Listed Important Wetlands of Australia
- Areas identified under the forest resource assessment process
- Reserved areas based on scientific study which have been identified as important plant communities and are threatened by a specific weed species (see below)

Reserved area nomenclature and assessment varies between jurisdictions, therefore a definitive list of reserves and their classifications cannot be supplied. It is up to each SCC member to identify the reserves to be included according to the principles outlined here. By example, the Parks and Wildlife Service of Tasmania has published “The reservation status of Tasmanian vascular plant communities”, which makes a sound basis on which to compile the required data

The number of these sites under threat as a result of each nominated weed species is requested, with a verification list similar to that required for Threatened Species above.

9.2.7 Non-provision of Data

Testing of weed species for WONS is data dependent. Where the data cannot be supplied for a species, this will render the weed ineligible for this round of WONS for your jurisdiction.

9.2.8 Consistency of Data

Consistency of data is critical as the ranking of WONS is based on weed species relativities. Data will be screened to assess the validity of estimates provided so as not to disadvantage other weed candidates. In some cases agencies may be asked to substantiate their data

Citations

Citations are marked in the body copy with a superscript numeral (lorem1). The author's name, publication and publication date, or other relevant information such as volume number, are referenced at the bottom of the page.

Administrative details report

The Administrative details report is only of interest to MLA staff, and should therefore be a separate report that may be placed on the project file. It should include:

- a financial report detailing total funds and assets provided by MLA for the purposes of the project
- total funds and other contributions supplied by the researcher (and others) to the project
- any project intellectual property
- commercial exploitation of the project - report on progress, if any